3-B
PROJECT DESCRIPTION: CONVEYANCE

FINAL ENVIRONMENTAL IMPACT STATEMENT

Brightwater Regional Wastewater Treatment System

APPENDICES

Brightwater
TREATMENT SYSTEM

Final

Appendix 3-B
Project Description:
Conveyance

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Introduction

King County has prepared a Draft Environmental Impact Statement (Draft EIS) and Final Environmental Impact Statement (Final EIS) on the Brightwater Regional Wastewater Treatment System. The Final EIS is intended to provide decision-makers, regulatory agencies and the public with information regarding the probable significant adverse impacts of the Brightwater proposal and identify alternatives and reasonable mitigation measures.

King County Executive Ron Sims has identified a preferred alternative, which is outlined in the Final EIS. This preferred alternative is for public information only, and is not intended in any way to prejudge the County's final decision, which will be made following the issuance of the Final EIS with accompanying technical appendices, comments on the Draft EIS and responses from King County, and additional supporting information. After issuance of the Final EIS, the King County Executive will select final locations for a treatment plant, marine outfall and associated conveyances.

The County Executive authorized the preparation of a set of Technical Reports, in support of the Final EIS. These reports represent a substantial volume of additional investigation on the identified Brightwater alternatives, as appropriate, to identify probable significant adverse environmental impacts as required by the State Environmental Policy Act (SEPA). The collection of pertinent information and evaluation of impacts and mitigation measures on the Brightwater proposal is an ongoing process. The Final EIS incorporates this updated information and additional analysis of the probable significant adverse environmental impacts of the Brightwater alternatives, along with identification of reasonable mitigation measures. Additional evaluation will continue as part of meeting federal, state and local permitting requirements.

Thus, the readers of this Technical Report should take into account the preliminary nature of the data contained herein, as well as the fact that new information relating to Brightwater may become available as the permit process gets underway. It is released at this time as part of King County's commitment to share information with the public as it is being developed.

Purpose

This Technical Memorandum (TM) presents a description of the Brightwater Conveyance System for each alternative that will be evaluated in the Final EIS. The TM includes current information and details of the following three conveyance system alternatives, which are depicted in Figure 1. (Figures are included at the end of this TM.)

- Route 9-195th Street Conveyance System (Preferred Alternative)
- Route 9-228th Street Conveyance System
- Unocal Conveyance System

The primary objective of the Brightwater Regional Wastewater Treatment System Project (Brightwater Project) is to implement the regional policy mandate (contained in the Regional Wastewater Services Plan [RWSP]) to construct a treatment plant and associated facilities in north King County or south Snohomish County. These facilities would provide wastewater capacity, thereby addressing the needs identified in the RWSP. The RWSP and regional policy mandate are intended to protect human health and the environment by providing high-quality wastewater treatment and conveyance services to this region.

A part of the Brightwater Project would be a conveyance system including pipelines, pump stations, and other facilities to transport wastewater to and from the treatment plant, and an outfall to discharge treated effluent into Puget Sound. The conveyance system would include a system of influent and effluent pipelines primarily constructed in tunnels. This new conveyance system is scheduled to be operational by 2010.

The conveyance system would be comprised of the following primary components:

- Influent pipeline for carrying untreated wastewater to the plant
- Effluent pipeline for carrying treated wastewater from the plant to the outfall (depending on the alternative selected)
- Pump stations to lift the wastewater to higher elevations (depending on the alternative selected)
- Portals to support tunneling construction

The location and type of influent and effluent pipelines required for the conveyance system would depend on the site selected for the treatment plant. Two potential sites for the treatment plant have been identified: the Route 9 site and the Unocal site. If the Route 9 site is selected, both influent and effluent pipelines would be required: (a) an influent pipeline to carry untreated wastewater from King County's existing sewer pipelines to the Route 9 site, and (b) an effluent pipeline to carry treated wastewater from the Route 9 site to the outfall. Connections to the existing sewer system in Kenmore and Bothell would occur at points in the system where flows from north and northeast King County and south Snohomish County come together. If the Unocal site is selected, an influent pipeline would be required to carry untreated wastewater from the existing pipelines to the Unocal site and the effluent would be discharged to an outfall adjacent to the Unocal site. Both the Unocal and Route 9 sites would require an outfall into Puget Sound.

One influent corridor was evaluated for the Unocal site. One influent corridor and two alternative effluent corridors were evaluated for the Route 9 site. Each Route 9 Conveyance System Alternative would consist of one effluent corridor and one influent corridor. A summary of the conveyance system alternatives is presented in Attachment A.

Conveyance System Flow Management

If the Brightwater Project is not constructed, King County would not be able to maintain a 20-year design flow standard. The probability of sanitary sewer overflows (SSOs) into the Sammamish River and the northern end of Lake Washington would increase, with a corresponding increased potential for environmental impacts to the two water bodies and public health issues. By 2020, approximately two overflows would occur annually somewhere in the service area if the Brightwater Project is not constructed.

The Brightwater System would be sized to accommodate flows up to 170 million gallons per day (mgd), which is the estimated peak flow generated in the service area during a 20-year flow event in 2050. During unusual flow conditions, storm-influenced flows could exceed either the capacity of the treatment plant or the conveyance system. King County could implement one or more of the following three flow management strategies to reduce the probability of SSOs during these unusual events:

1. Divert wastewater to King County's West Point and South Treatment Plants through the Kenmore Interceptor Section 2 and the Eastside Interceptor, respectively.

2. Divert excess flows into the 4 million gallon (MG) Logboom Park Storage Facility and the 6 MG North Creek Storage Facility. The stored wastewater would then be returned to the conveyance system once peak flows have subsided and conveyance capacity is available.

3. Implement controlled surcharging of select conveyance pipelines to provide additional flow storage.

The implementation of these flow management strategies would help to reduce the probability of SSOs in the conveyance system or at the treatment plant. During extreme or prolonged flow events or operational emergencies that exceed available flow management procedures, the system would be designed so that wastewater SSOs occur in selected natural receiving waters through a safety relief point before overflowing at other locations.

Conveyance System Features Common to All Alternatives

Many of the conveyance system features are common to all of the conveyance system alternatives. These common features include influent connections, pipelines and tunnels, portals, construction methods, and permanent facilities, which are discussed in the following sections.

Influent Connections

The influent tunnel for both the Route 9 and Unocal Conveyance System alternatives would receive flows from the following locations, which are illustrated in Figures 2 and 3.

Kenmore Area (Swamp Creek Trunk, Bothell-Woodinville Interceptor, Inglewood Interceptor). Under the proposed Brightwater Flow Management Plan, the Inglewood, Swamp Creek–King, Kenmore Section 5, and Bothell basins would be diverted at the proposed Kenmore Diversion Structure and proposed Portal 44 (depending on the conveyance system alternative) to the new Brightwater Treatment Plant. Basin flows downstream of the remaining Kenmore Pump Station would continue to be conveyed in the Kenmore Interceptor Section 2 (Kenmore Lakeline) for processing at the West Point Treatment Plant. During emergency conditions, additional flows could bypass the Kenmore Diversion Structure and be conveyed to the West Point Treatment Plant.

In addition, two local connections would be constructed to divert the Lake Forest and Lake Forest-Snohomish basins. These connections would be located in Kenmore in the vicinity of 175th Avenue and 61st Avenue. The connections to the two basins would be diverted to the proposed Kenmore diversion structure. The flow would then be directed to proposed Portal 11.

North Creek Area (Bothell-Woodinville Interceptor, North Creek Interceptor, Bear Creek Trunk, York Pump Station Force Mains). Under the proposed Brightwater Flow Management Plan, flows from the Hollywood Pump Station basins, Woodinville–SE, Woodinville, East Woodinville, Cross Valley, Bear Creek-King, North Creek-King, and North Creek-Snohomish basins would be conveyed to the Brightwater Wastewater Treatment Plant at a proposed diversion structure at Portal 14 or 41 (depending on the conveyance system alternative). During emergency conditions, peak flows could bypass the North Creek Diversion Structure to the Kenmore/Bothell-Woodinville Interceptor for processing at the West Point Treatment Plant or diverted by the existing York Pump Station to the Eastside Interceptor and the South Treatment Plant.

Pipelines and Tunnels

Most of the conveyance pipelines with diameters greater than eight feet would be constructed by tunneling methods using tunnel boring machines (TBMs). Some relatively smaller conveyance pipelines (diameters less than eight feet) would be constructed by microtunneling using microtunnel boring machines (MTBMs). Other construction methods such as open cut or bore-and-jack construction may be used for constructing pipelines that connect new tunnels and pump stations to existing facilities. These pipelines are relatively short and would range in length from approximately 100 to 2,500 feet.

The pipelines would be either gravity pipelines, pressure pipelines, or force mains. In gravity pipelines, the influent or effluent flows by gravity, and the pipe is not necessarily flowing full. In pressure pipelines and force mains, the pipe is full, and the influent or effluent flows by pressure. The pressure in a pressure pipeline results from a source of flow at a higher elevation. In force mains the pressure is generated by a pump station. Pipelines generally range between two and 12.5 feet in diameter. The size and length of the conveyance pipelines for each alternative are included in Attachment A. Where tunneling construction is used, the pipelines would be placed within the tunnels, or, the inside of the tunnel structure would serve as the conveyance pipe. When the influent and effluent pipelines follow the same corridor, both the influent and effluent pipelines would be placed within a single, larger-diameter tunnel. The volume in the tunnel between the pipelines would be filled with cement grout.

Pipeline sizes and configuration (number of pipes) is based on optimizing tunnel diameter, head losses, and tunnel depth. Specifying two pipelines versus one single pipeline allows in some cases a smaller tunnel diameter but increases head loss. To avoid the need to pump effluent, head losses are balanced with tunnel depth. In general, minimizing both pipelines and tunnel diameters and tunnel depth, while still avoiding the need for pumping, minimizes project cost. During design, further pipeline optimization would be performed using hydraulic modeling programs.

The tunnels could range in depth from approximately 40 feet to over 450 feet below the ground surface. Tunnel outer diameters could range from approximately 14 to 24 feet depending on the size and number of pipelines contained within the tunnel. Microtunnels could range between five and eight feet in diameter. Specific information regarding the tunnel and pipeline diameters for each of the conveyance system alternatives is contained in the conveyance system alternatives sections and in Attachment A. The tunnels would be constructed within a utility easement when under private property (estimated to be between 22 and 52 feet wide depending on tunnel diameter and location).

Portals

Portals provide access from the ground surface for launching and retrieving TBM equipment and installing pipes during construction, as well as long-term access to the tunnels for maintenance. Portal siting areas are 2,000-foot-diameter (72-acre) areas within which a minimum of one to two acres would be selected for portal construction. Multiple candidate sites for the one- to two-acre portal site were identified within each portal siting area. These candidate sites were identified based on site visits and known or available information. Sensitive areas such as wetlands or high-quality upland habit or forested areas were avoided wherever possible. Priority was given to sites that were publicly owned or to undeveloped or under-developed sites. Developed property was evaluated if there were no undeveloped or under-developed sites within the portal siting area. Among the developed properties, publicly owned sites, commercial/industrial, and residential sites were considered. A minimum site size of one to two acres was established to provide adequate area for equipment access, staging, and operation during construction.

The portal siting areas are designated as either primary or secondary. Primary portals would be required for feasible tunnel construction for drive lengths (distances between portals) of approximately 20,000 feet. Primary portal siting areas have been identified along each corridor at intervals of approximately 20,000 feet. Secondary portal sites are not expected to be used. However, they may be required based on geotechnical analysis performed during final design. A decision on the need for secondary portals will not be made until final design is completed. If needed, secondary portals may be used for temporary ventilation, ground improvement, and/or grouting supply. If required, secondary portals would be located within approximately 10,000 feet of another primary or secondary portal.

Each primary portal would be designated as a working or retrieval portal. The portal where the TBM operation starts would be termed a “working” portal, or a “launching” portal. This is because the TBM would be assembled and started (launched) from this portal, and the tunnel excavation, lining, and ventilation operations would follow the TBM (i.e., most of the work would occur at these portals). A second portal would be required at the end of each segment. Once the tunnel segment is completed, the TBM would be removed (recovered or received) from the tunnel through these portals, often called “recovery” or “receiving” portals. The recovery portal also would provide ventilation and egress and access during the final lining, clean up, and testing stage of the project. Figures 5 and 6 show typical layouts of working and receiving portals during construction.

Construction Methods

Most of the conveyance system would be constructed by tunneling. Other construction methods such as microtunneling, bore-and-jack, or open cut construction may be used for constructing pipelines that connect new tunnels to existing sewer facilities. The following paragraphs summarize each of these construction methods. See Appendix 3-G to the Final EIS for a detailed discussion of conveyance construction methods.

Conventional Tunneling

The majority of the conveyance system would consist of TBM-excavated tunnels. Construction of the tunnels would be performed using TBMs, which excavate the ground and simultaneously install concrete lining, in the shape of a pipe, as the TBM advances. The system would be divided into individual tunnel segments, which would range in length from approximately 10,000 to 20,000 feet. Each segment would require the construction of a working portal at the start of the tunnel and a receiving portal where the segment ends.

The majority of construction activity for any tunnel segment would take place at the working portal. The TBM is assembled and started from this portal, and the tunnel excavation, lining, and ventilation operations, all of which follow the TBM, are supported by work performed on the ground surface around this portal. The receiving portal is primarily used to remove the TBM from the tunnel once excavation is complete.

Construction at each portal site would fall into thee major activities:

- Site preparation and portal construction
- Tunnel excavation and initial lining
- Final lining of the tunnel and portals

Site preparation and portal construction activities could include grading, and would include fencing, excavation, and support of portals. The work during this period would focus on the installation of a portal structure, which would extend from the ground surface to the elevation of the tunnel. Once the portal structure is complete, the TBM would be lowered into the portal to excavate the tunnel. The operation and forward motion of the TBM would consist of excavating the ground and concurrently installing the initial lining behind the TBM as it moves along in the ground. The initial lining would consist of pre-cast reinforced concrete segments, which upon assembly form a cylindrical pipe. Shortly after the concrete segments are placed, the annulus around them would be sealed with cement grout to minimize groundwater inflows, to reduce settlement, and to provide a uniform loading on the completed tunnel segments. During the work, these underground operations would be supported by activities at the ground surface surrounding the working portal. This support would be provided by several cranes and other earthwork equipment (e.g., a bucket loader), fans, pumps, and trucks to remove the spoil material from the site and to deliver the precast concrete lining units and other ancillary (e.g., grout) supplies. Once the tunnel is excavated and the initial lining is complete, the TBM would be removed through the receiving portal.

In some tunnel sections, several different final (second pass) lining systems would be considered, including cast-in-place (CIP) concrete or pipe backfilled with grout. For any of these lining systems, the work to install them would include delivery of materials into the tunnel at the working portal(s). Products (pipe, concrete, or grout) would be delivered to the site in trucks and lowered into the tunnel with cranes, where they would then be delivered to the head of the tunnel in/on rail cars. For some lining systems, a second stage of grouting would be required to fill gaps between the initial and final lining.

The portal and tunnel construction methods utilized for the conveyance system would include control of groundwater. The design would require watertight construction methods for the portals, such as concrete-diaphragm walls or interlocking steel-sheet piles, so that maximum seepage into any given portal would not exceed approximately 250 gallons per minute (gpm). If necessary, groundwater control at the portals helps to provide a stable excavation shoring system. It is expected that groundwater control would be limited to either temporary local pumping to de-pressurize the soils or using localized soil conditioning to reduce the groundwater flow. For the tunneling, the majority of water removed at the portals is expected to consist of the retrieval of water that has been used to operate the TBM (cooling water, etc.) It is expected that the initial (single pass) lining system would provide a nearly dry tunnel, and seepage, if it does occur, would be only for limited durations through the front face and excavation chamber of the TBM. Water that would be generated from construction would be treated at the site and discharged into local sanitary sewers, storm drains, or water bodies in accordance with regulatory requirements.

Microtunneling

Some portions of conveyance pipeline (connections to the existing system) could be installed by microtunneling. Microtunneling differs from conventional tunneling in that the diameters of microtunnels are smaller and the microtunneling TBM (MTBM) is remotely operated. Each length of microtunnel requires two portals, often referred to as pits, to both launch and retrieve the MTBM. A working area would be required adjacent to the launch pit to provide the space for support activities. However, the work area would be smaller than a work area required for conventional tunneling. When pipe installation is complete, the launch and retrieval pits would be backfilled and returned to their original condition.

Open-Cut Construction

At some locations, open-cut construction could be used to connect existing facilities (near surface sewer lines) to the newly-constructed tunnels. Open-cut construction utilizes conventional earthwork equipment to excavate a trench, place a pipe within it, and backfill the trench. This construction method is typically used where the pipeline depth is less than 30 feet. In typical open-cut construction, excavation, installation and backfilling proceed simultaneously along a stretch of the work zone. Open-cut construction work areas vary depending on the size and number of pipelines to be installed.

Permanent Facilities

As part of the conveyance system, several types of permanent facilities would be constructed at the primary portal sites. These facilities would manage the flow and hydraulics throughout the conveyance system. Facilities would include hydraulic control structures such as diversion structures, drop structures, and transition structures as well as other facilities such as dechlorination, chemical injection, sampling, and odor control facilities.

Diversion Structures

Diversion structures are underground vaults used to collect or divert flow from existing sewers into the new conveyance system. Diversion structures would be required to convey flow from the Kenmore and North Creek areas into the influent tunnel. Diversion structures would be equipped with control gates for flow-routing flexibility. While the existing system’s functionality would be maintained, the new conveyance system would add to the existing flexibility. Diversion structures would be constructed in the following areas:

Kenmore Area. For the Route 9 alternatives, the Kenmore area diversion structure would be located in the vicinity of the existing Kenmore Pump Station and would direct flows to Portal 11, which is the beginning of the influent tunnel. For the Unocal alternative, the diversion structure would be located at the existing Kenmore Pump Station and would direct flows to the new Kenmore Pump Station.

North Creek Area. For the Route 9 alternatives, the existing North Creek diversion structure would be modified, and a new diversion structure would be constructed in the vicinity of the existing North Creek Storage Facility. The diversion structure would convey flows to either the existing storage facility or the influent tunnel via a drop structure at Portal 41. For the Unocal alternative, the existing North Creek diversion structure would be modified to divert flows to the influent tunnel via a drop structure at Portal 14.

Drop Structures

Drop structures are concrete in-ground vaults that are used to combine flows from two locations where one location is much deeper than the other. A drop structure would facilitate the discharge of the flow to the influent tunnel if there were a change in elevation between the existing sewer and tunnel. The drop structure would connect directly to the influent tunnel at one of its portals. The drop structure would be designed with a vortex-flow vertical drop where a vortex flow is generated by the design of water clinging and flowing down the walls of the drop shaft. The vortex flow provides energy dissipation in the drop shaft through the friction losses of the wall. The diameter of the drop shaft is dictated by the peak flow through the structure. A deaeration chamber is provided so that air is not introduced to the influent tunnel. The required vertical drop in the drop structure would depend on the selected portal. Drop structures would be located in the following areas:

> **Kenmore Area**. For the Route 9 alternatives, a drop structure would be provided at Portal 11 and Portal 44. For the Unocal alternative, a drop structure would be required at Portal 11.
>
> **North Creek Area**. For the Route 9 alternatives, a drop structure would be required at Portal 41. For the Unocal alternative, a drop structure would be required at Portal 14.

Transition Structure

A transition structure is an underground vault that is used to transition flows from one pipe material and/or diameter to another diameter. For the Route 9 alternatives, a transition structure would be needed to transition flows from pressure to gravity at Portal 5 and from the effluent tunnel to the outfall at Portal 19.

Odor Control Facilities

Odor control facilities would be located on the influent tunnels and effluent tunnels at locations where air could potentially exit the conveyance system. Odor control would not be needed for the outfall. The conveyance system odor control technologies would be consistent with other King County conveyance system odor control projects. Both liquid-phase treatment technologies and vapor-phase treatment technologies are being considered in predesign. A detailed description of odor control methodologies being considered for the conveyance system is provided in Attachment B.

Liquid-phase treatment technologies treat dissolved sulfide in the liquid stream, preventing the generation of hydrogen sulfide, which is both an odorous and corrosive compound. Liquid-phase treatment would likely be used at both North Creek and Kenmore pump stations for either the Route 9 or Unocal Conveyance System Alternatives. The liquid-phase treatment technologies preferred for the conveyance system would include sodium hypochlorite, calcium nitrate, and iron salts.

Vapor-phase treatment affects air emanating from sewers by removing odor-causing compounds from the gaseous stream prior to discharge to the atmosphere. The most common sewage system odor, often compared to the smell of rotten eggs, is attributable to hydrogen sulfide. Other reduced sulfur compounds and low-molecular-weight volatile organic compounds can also be part of a sewer. Vapor-phase treatment facilities would likely be constructed in both the North Creek (Portals 41 or 14) and Kenmore (Portals 11 and 44) areas for the Route 9 and Unocal alternatives. Additional vapor-phase treatment facilities would be required for the Unocal alternative at Portal 7 and for the Route 9 alternatives at Portal 5. Two-stage vapor-phase treatment would consist of some combination of bioscrubber, biofiltration, activated carbon, or chemical scrubber.

Dechlorination Facility

A dechlorination facility would be constructed to remove the total chlorine residual that exists after chlorination before discharge to Puget Sound. Dechlorination would be applied to the treated wastewater effluent after disinfection at the Route 9 site. The dechlorination facility would be used for both the Route 9 Conveyance System Alternatives, but would not be needed for the Unocal Conveyance System. The dechlorination facility would be located at the following portal areas:

- Route 9-195th Street Conveyance System Alternative: Portal 5
- Route 9-228th Street Conveyance System Alternative: Portal 26

Dechlorination involves the addition of sodium bisulfite to the effluent. The dechlorination facility would include a bisulfite-mixing box, a chlorine residual monitoring and controlling system, and a bisulfite storage and metering system. Storage tanks with a volume of about 5,000 gallons each would also be part of the facility. The facility would include one service tank and one redundant storage tank within a concrete spill containment sump and a pump/electrical building and related piping and instrumentation systems. The overall site would be approximately 0.5 acre and would include space for landscaping and security around the building. The building would be approximately 40 feet by 20 feet and about 20 feet in height. A typical site layout is shown in Figure 7.

Sampling Facility

A sampling facility would be needed to measure the residual chlorine levels in the effluent tunnel prior to discharge into Puget Sound. The sampling station would likely be located at the transition between the conveyance tunnel and the outfall. It could also be located next to the dechlorination facility. The sampling facility could be located at the following areas:

- Route 9-195th Street Conveyance System Alternative: Portal 19 or 5.
- Route 9-228th Street Conveyance System Alternative: Portal 19 or 26.

The sampling facility would consist of an underground vault with a continuous residual chlorine monitor and data logger. The vault would be approximately 20 feet long by 20 feet wide. Periodic effluent samples would be collected from the vault on a weekly basis.

Chemical Injection Facilities

Chemical injection is a liquid-phase treatment to reduce corrosion and odor-causing hydrogen sulfite in the influent pipes. Chemical injection facilities are used to add chemicals to wastewater to control the release of corrosive compounds in the system. Injected chemicals treat hydrogen sulfide, which is the major cause of odor and corrosion in the influent conveyance system. Hydrogen sulfate is prevented from leaving the wastewater liquid phase and corroding conveyance structures. Iron salts, calcium nitrate, and sodium hypochlorite are typically used chemicals. Chemical injection facilities would be located at existing pump stations within the influent conveyance system. A typical chemical injection facility would include chemical storage tanks, metering pumps, valves and piping, and control panel equipment for injecting chemicals into the influent system.

Conveyance System Alternatives

Three conveyance system alternatives will be evaluated in the Final EIS. Current information and details regarding the Conveyance System Alternatives are included in this section.

Route 9-195th Street Conveyance System

The Route 9-195th Street Conveyance System would consist of a conveyance corridor including both an influent pipeline to a treatment plant built at the Route 9 site in unincorporated Snohomish County north of Woodinville and an effluent pipeline to an outfall (Zone 7S) off Point Wells. The influent pipeline, effluent pipeline, and portals for constructing the tunnels are shown on Figure 8. This proposed conveyance system is the Preferred Alternative and would generally follow NE 195th Street and 205th Street. The majority of the Route 9-195th Street Conveyance System would be located in King County. An influent pump station would be located at the Route 9 plant site. Because the conveyance system would be a combination of pressure pipelines and gravity system, no other pump stations would be required within the conveyance system.

Affected jurisdictions for the Route 9-195th Street Conveyance System Alternative would include the cities of Woodinville, Bothell, Kenmore, Lake Forest Park, Shoreline, the Town of Woodway, and Snohomish County.

Influent Pipeline

The influent conveyance system would consist of pipelines constructed primarily by tunneling. A relatively short segment between the North Creek Pump Station and Portal 41 would be constructed by microtunneling construction methods. Open-cut construction and/or microtunneling would be used to connect the existing wastewater system to the new influent tunnel at Portal 11 and at Portal 44. The route of the influent conveyance alignment crosses Bothell Way NE (SR-522) between Portal 11 and 68th Avenue NE. At 68th Avenue NE, the alignment continues north to NE 195th Street and turns east along 195th Street to Portal 44, continues along NE 195th Street through the North Creek Business Park (Portal 41) to SR-522, and then north along SR-522 to the Route 9 site.

A profile of the influent tunnel is shown in Figure 9. A summary of conveyance characteristics is shown in Table 1.

The Route 9-195th Street Conveyance System Alternative would combine the influent and effluent pipelines in one larger-diameter tunnel along 195th Street and SR-522, between portal 44 and the Route 9 site. Figure 10 shows a cross section of the tunnels.

Local Connections

Several local connections would be made to the existing sewer system to direct flows to the Route 9 site via the Route 9 - 195th Street Conveyance System. Connections would be made to the following facilities:

- Kenmore Pump Station
- Swamp Creek Trunk Sewer
- Kenmore Local Sewer System
- North Creek Pump Station

Kenmore Pump Station Connection

The existing Kenmore-Bothell Interceptor conveys flows to the Kenmore Pump Station. The Kenmore-Bothell Interceptor connects to the Kenmore Pump Station's influent structure. A new diversion structure would replace the existing Kenmore Pump Station influent structure. A 72-inch diameter pipeline would convey flow to Portal 11 from the proposed diversion structure and connect to the influent tunnel via a drop structure that would be located within Portal 11. The 72-inch pipeline connecting the diversion and drop structures would be approximately 100 to 1,500 feet long depending on the location of the Portal 11 site. The 72-inch diameter pipeline would be constructed by either open-cut or microtunneling construction methods.

Swamp Creek Trunk Connection

The Swamp Creek Trunk currently flows into the Bothell-Woodinville Interceptor and to the Kenmore Pump Station. The Swamp Creek Trunk alignment is close to the proposed location for Portal 44; therefore, Swamp Creek flow from north of 195th Street may be diverted to Portal 44 directly. Swamp Creek flows south of 195th Street would flow into the Bothell-Woodinville Interceptor and to the Kenmore Pump Station. A new manhole would be constructed on the existing Swamp Creek Trunk in the vicinity of NE 195th Street and 73rd Avenue NE. A new 36-inch diameter pipeline would be constructed along NE 195th Street between 73rd Avenue NE and Portal 44. (See Figure 11.) The pipeline would discharge into the drop structure located in Portal 44. The drop structure would connect to the influent tunnel. The 36-inch diameter pipeline would be constructed by either open-cut or microtunneling construction.

Kenmore Local Sewer System Connection

Two local connections would be made to the existing sewer system in the Kenmore area. These connections would be located in the vicinity of 175th Avenue and 61st Avenue. The flow would be directed to Portal 11. A 21-inch diameter pipeline would be constructed along 175th Avenue between 61st Avenue and the Kenmore Pump Station. (See Figure 12.) The 21-inch diameter pipeline would discharge to the drop structure located in Portal 11. The drop structure would connect to the influent tunnel. The pipeline would be constructed by either open-cut or microtunneling construction.

North Creek Pump Station Connection

The existing North Creek Pump Station receives flows from the Bothell-Woodinville Interceptor and the North Creek Trunk via the existing North Creek diversion structure. Flows can be conveyed to the existing North Creek Pump Station or, during periods of wet weather, to the North Creek Storage Facility or the Kenmore Pump Station via the Kenmore-Bothell Interceptor. This entire system would connect directly to the new influent tunnel via a diversion structure.

The diversion structure could be either a new diversion structure or the existing North Creek diversion structure could be modified to accommodate the new conveyance system. The diversion structure would divert the North Creek flows to Portal 41. A new 72-inch diameter pipeline would convey flows from the diversion structure to a drop structure located within Portal 41. The drop structure would connect to the proposed influent tunnel.

The 72-inch diameter pipeline would be approximately 100 to 4,000 feet in length depending on the location of Portal 41. The connection would be constructed by microtunneling with some open-cut construction on the Portal 41 site and at the North Creek Pump Station.

Effluent Pipeline

The effluent conveyance for the Route 9-195th Street Conveyance System would be combined in the same tunnel with the influent from the Route 9 site south along SR-522 and west along NE 195th Street to Portal 41 near the intersection of NE 195th Street and 120th Avenue NE. The tunnel would follow NE 195th Street to Portal 44 at 80th Avenue. At this point, the effluent conveyance would diverge from the influent conveyance and would continue west along NE 195th Street in public and private rights-of-way until reaching Ballinger Way NE. The corridor then would turn northwest along Ballinger Way NE until intersecting with Portal 5 at NE 205th Street (King County designation)/244th Street SW (Snohomish County designation) at the King/Snohomish County boundary. From this location, the corridor would run west along NE 205th Street until reaching Puget Sound at Point Wells (Portal 19), where it would connect to the Zone 7S outfall.

The Route 9-195th Street Conveyance System would avoid the need for an effluent pumping station. The effluent pipeline would have a high point at Portal 5. See Figure 13 for a profile showing the effluent tunnel depth. The final tunnel depth would be determined during design, based on geotechnical considerations and hydraulics.

Table 1. Summary of Conveyance Characteristics for Route 9-195th Street Conveyance System Alternative

Characteristic	Description
Construction Method	**Tunnel:** Portal siting area 44 to portal siting area 41 Portal siting area 41 to Route 9 plant site Portal siting area 11 to portal siting area 44 Portal siting area 44 to portal siting area 5 Portal siting area 5 to portal siting area 19 **Microtunnel:** North Creek Pump Station to portal siting area 41 **Open-cut Construction or Microtunnel:** Connection between Kenmore Pump Station and Portal 11 Kenmore Local connection to Portal 11 Swamp Creek connection to Portal 44
Conveyance approximate lengths and diameters (based on peak flow of 170 mgd)	**Total Tunnel Alignment Length and Local Connection Pipeline Length– 15.9 miles (gravity and pressure pipes)** **Influent Tunnel Alignment Total** – 3.3 miles including 1.8 miles of local connections (8.1 miles including the 4.8 miles of combined tunnel section) Influent tunnel from portal siting area 11 to portal siting area 44: • 1.5 miles of 14-ft diameter tunnel (10-ft inner diameter influent pipeline) **Local Influent Connections Total** – 1.8 miles North Creek Pump Station to portal siting area 41: • 0.8 mile of 72-inch diameter influent microtunnel Kenmore Pump Station to portal siting area 11: • 100 to 1,500 feet of 72-inch diameter influent (depends on location of the portal site) Kenmore Local connection to Portal 11: • 0.5 mile of 21-inch diameter influent (open-cut or microtunnel) Swamp Creek connection to Portal 44: • 0.5 mile of 36-inch diameter influent (open-cut or microtunnel) **Combined Tunnel Alignment Total** – 4.8 miles (includes both influent and effluent pipelines) Combined influent and effluent tunnel from portal siting area 44 to portal siting area 41: • 2.4 miles of 24-ft diameter tunnel (11-ft inner diameter influent pipeline and twin 6-ft inner diameter effluent pipelines) Combined influent and effluent tunnel from portal siting area 41 to Route 9 plant site: • 2.4 miles of 24-ft diameter tunnel (twin 8-ft inner diameter influent pipelines and twin 6-ft-inner-diameter effluent pipelines)

Table 1. Summary of Conveyance Characteristics for Route 9-195th Street Conveyance System Alternative (continued)

Characteristic	Characteristic
	Effluent Tunnel Alignment Total – 7.8 miles (12.6 miles including the 4.8 miles of combined tunnel section) Effluent tunnel from portal siting area 44 to portal siting area 5: • 4.1 miles of 14-ft-diameter tunnel (10-ft inner diameter effluent pipeline) Effluent tunnel from portal siting area 5 to portal siting area 19: • 3.7 miles of 14-ft-diameter tunnel (10-ft inner diameter effluent pipeline)
Portal vicinity	**Primary:** Portal 11 – NE 175th Street and 68th Avenue NE Portal 44 – NE 195th Street and 80th Avenue NE Portal 41 – NE 195th Street and 120th Avenue NE Portal 5 – NE 205th Street and Ballinger Way NE Portal 19 – NW 205th Street and Richmond Beach Drive NW **Secondary:** Portal 45 – NE 195th Street and 55th Avenue NE Portal 7 – Ballinger Way NE and 25th Avenue NE Portal 27 – NE 205th Street and 1st Avenue NE Portal 23 – NW 205th Street and Firdale Avenue
Approximate primary portal depths	Portal 11 – 45 feet Portal 44 – 80 feet Portal 41 – 90 feet Portal 5 – 180 feet Portal 19 – 40 feet
Pipeline material	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In combined tunnel sections or where additional lining is required due to internal or external pressure, a “second-pass” lining of steel pipe, fiberglass pipe, or CIP concrete, which may include a membrane, would be used. **Microtunnel:** Reinforced concrete pipe or fiberglass pipe **Open-cut connection:** Welded-steel pipe, fiberglass pipe, or reinforced-concrete pipe

Route 9-195th Street Conveyance System Siting Areas

The Route 9-195th Street Conveyance System would contain primary and secondary portal sites. Five primary portals would be constructed (Portals 11, 44, 41, 5, and 19), the deepest of which would be approximately 180 feet (Portal 5). Table 2 contains a summary of the primary and secondary portals and construction characteristics associated with primary portals. Portal construction characteristics include: purposes of primary portals, portal construction methods, dewatering volumes, earthwork volumes removed from site (including tunnels), and construction duration at the primary portal sites.

Table 2. Summary of Portal Characteristics for Route 9-195th Street Conveyance System Alternative

Characteristic	Description
Construction purposes of primary portals	Portal 11 – TBM launch, spoils receiving, local connection to Bothell-Woodinville Interceptor and Juanita Interceptor Portal 44 – TBM launch, TBM retrieval, spoils receiving, local connection to Swamp Creek Trunk Portal 41 – TBM launch, spoils receiving, local connection to Bothell-Woodinville Interceptor, North Creek Sewer Interceptor Portal 5 – TBM retrieval, may be used to provide lining supplies to the tunnel following removal of the TBM Portal 19 – TBM launch, spoils receiving
Primary portal probable construction methods	Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert. Portal 44 – Concrete slurry walls with a jet-grout invert slab to provide groundwater cut-off and invert stability; localized sumps will be used to de-pressurize the invert as excavation proceeds. Portal 41 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert; alternatively jet grouting could be used to control invert seepage and provide a stable invert. Portal 5 – Concrete caisson construction or concrete slurry walls installed to depth of approximately 75 ft, excavation in the wet or dry to this depth, followed by sequential excavation and concrete lining to full depth. Portal 19 – Interlocking steel-sheet pile walls, with a jet-grout invert plug to control seepage and provide for a stable invert. Local sump pump may also be required to de-pressurize invert.

Table 2. Summary of Portal Characteristics for Route 9-195th Street Conveyance System Alternative (continued)

Characteristic	Description
Primary portal dewatering rates	Portal 11 - 20 to 80 gpm for 0.5 year of portal construction - Up to 80 gpm for 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time - Up to 50 gallons per minute (gpm) for 1 year of tunnel lining Portal 44 - 1 to 10 gpm for 0.5 year of portal construction - Up to 140 gpm for 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 110 gpm for 1 year of tunnel lining Portal 41 - 20 to 100 gpm depending on use of jet grout for 0.5 year of portal construction - Up to 100 gpm for 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time - Up to 70 gpm for 1.5 years of tunnel lining Portal 5 - 1 to 10 gpm for 1 year of portal construction activity. Portal 19 - 1 to 10 gpm for 0.5 year of portal construction - Up to 130 gpm for 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 100 gpm for 1 year of tunnel lining
Primary portal earthwork volumes	Total: 31,000 yd^3 Portal 11 – 4,000 yd^3 Portal 44 – 8,000 yd^3 Portal 41 – 9,000 yd^3 Portal 5 – 6,000 yd^3 Portal 19 – 4,000 yd^3
Tunnel earthwork volumes	Overall total: 874,000 yd^3 Reach 11-44 – 52,000 yd^3 Reach 44-41 – 277,000 yd^3 Reach 41-TP – 277,000 yd^3 Reach 44-5 – 161,000 yd^3 Reach 5-19 – 107,000 yd^3

Table 3 summarizes the portal candidate sites for each of the portal siting areas. Candidate site information includes site size and roads that would likely be used to access the site. The candidate sites are shown in the figures contained in Attachment C.

Table 3. Summary of Portal Candidate Sites for Route 9-195th Street System Alternative

Portal	Candidate Sites	Size (Acres)	Access Roads
Primary Portals			
11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	68th Avenue NE/Juanita Drive NE 175th Street Bothell Way NE (SR-522)
44	Site 44-C Site 44-D Site 44-E	3.6 8.8 2.3	NE Bothell Way (SR-522) 80th Avenue NE NE 195th Street
41	Site 41-A Site 41-C Site 41-D Site 41-X Site 41-W Site 41-J	6.7 16.1 4.6 5.1 3.3 3.7	I-405 NE 195th Street 120th Avenue NE North Creek Parkway Beardslee Boulevard Ross Road
5	Site E5-B Site E5-G Site E5-X	3.3 1.8 1.0	SR-104 (Ballinger Way NE) 15th Avenue NE
19	Site E19-A Site E19-C Site E19-E	1.9 8.5 3.4	SR-99 N 185th Street Fremont Avenue NW Richmond Beach Road NW 195th Street NW 196th Street Richmond Beach Drive
Secondary Portals			
45	Site E45-A Site E45-C Site E45-D	1.9 3.2 3.8	SR-522 (Bothell Way) 61st Avenue NE 55th Avenue NE NE 190th Street / NE 193rd Street
7	Site E7-A Site E7-B Site E7-C	9 2.9 4.5	I-5 SR-104 (Ballinger Way NE) 25th Avenue NE
27	Site E27-A Site E27-B Site E27-C	7.2 2.9 2.6	SR-104 (Ballinger Way NE) 1st Avenue NE 76th Avenue W 242nd Place SW
23	Site E23-A Site E23-D Site E23-F	3.1 2.2 1.5	SR-104 (Ballinger Way NE) 244th Street SW Firdale Avenue 8th Avenue NW / 100th Avenue W

Permanent Facilities

Permanent facilities would be located at portal sites for the Route 9-195th Street Conveyance System Alternative. A summary of the permanent facilities is shown in Table 4.

Odor Control Facilities

Odor Control Facilities would be located within the influent conveyance system and along the effluent conveyance system. The treated effluent is not expected to contain odorous air; however, air would be released from the effluent pipeline at Portal 5. Therefore, odor control would be provided. A general discussion about these facilities is provided in the *Conveyance System Features Common to All Alternatives* section. As a precaution, odor control facilities for each of the locations are discussed below.

Portal 11 Odor Control. The proposed odor control program located at Portal 11 would include:

- Hydrogen sulfide concentration design standard of 75 ppm annual peak and 15 ppm daily average. These concentrations are based on site-specific conditions and will be confirmed following the Summer 2003 monitoring and sampling program.
- Estimated flow rate volume of 9,000 cfm to be treated
- Two-stage odor control systems, either two carbon units or a combination chemical scrubber and carbon unit, to meet the 99.99 percent removal design standard
- Reuse of the Kenmore Pump Station chemical injection facility to provide chemical dosing of the Bothell/Kenmore and Swamp Creek flows

Figure 14 is a layout of a typical odor control facility at Portal 11

Portal 41 Odor Control. The proposed odor control measures for the Woodinville/Bothell Interceptor and North Creek Trunk System located at Portal 41 would include:

- Hydrogen sulfide concentration design standard of 150 ppm annual peak and 30 ppm daily average. These concentrations are based on site-specific conditions and will be confirmed following the Summer 2003 monitoring and sampling program.
- Estimated air volume of 11,000 cfm to be treated; and two- or three-stage odor control systems, either a bioscrubber and two chemical scrubbers, or a combination chemical scrubber and carbon unit, to meet the 99.99 percent removal design standard
- Upgrade of the North Creek Pump Station chemical injection facility to provide chemical dosing at the diversion structure

Figure 15 is a layout of a typical odor control facility at Portal 41

Portal 44 Odor Control. The proposed odor control program located at Portal 44 would include:

- Hydrogen sulfide concentration design standard of 75 ppm annual peak and 15 ppm daily average. These concentrations are based on site-specific conditions and will be confirmed following the Summer 2003 monitoring and sampling program.
- Estimated flow rate volume of 9,000 cfm to be treated
- Two-stage odor control systems, either two carbon units or a combination chemical scrubber and carbon unit, to meet the 99.99 percent removal design standard

Portal 5 Odor Control. The proposed odor control program located at Portal 5 would include:

- Treated effluent
- Estimated flow rate volume of 2,000 cfm to be treated
- Single-stage passive system carbon limit or biofilter

Table 4. Summary of Permanent Facilities at Portal Sites for Route 9-195th Street Conveyance System Alternative

Location	Facility	Structure Size (sq.ft.)	Equipment	Quantity
Portal 11	Drop Structure (Below ground)	500 (Inside Portal 11)	None	---
	Odor Control Facility with Electrical Room	1,500 with 400 for electrical room	Compressor/Bubblers Carbon Scrubbers Fan Electrical Panels	22 2 2 4
Kenmore Pump Station	Chemical Injection Facility at Kenmore Pump Station	Use Existing at Kenmore Pump Station	Use Existing (reroute piping)	---
	Diversion Structure (Below ground)	500	72-in Slide Gates/Actuators	3
Portal 41	Drop Structure (Below ground)	500 (inside Portal 41)	None	---
	Odor Control Facility with Electrical Room	2,000 (at Portal 41) with 400 for electrical room	Chemical Scrubber Carbon Scrubber Fan Electrical Panels	1 1 2 4
North Creek Pump Station	Chemical Injection at North Creek Pump Station	Reuse existing facilities plus 400 for a second tank	7,000 gal Tank/Pump	1
	Diversion Structure (Below ground)	500	72-in Slide Gates Compressor/Bubbler	3 1
Portal 5	Air Handling and Odor Control Facility with Electrical Room	1,000 with 400 for electrical room	Passive Carbon or Biofilter System Electrical Panels	1 3
	Transition Structure (Below ground)	300	None	---
	Dechlorination Facility	1,200	Tank/Metering Pump	1
Portal 44	Drop Structure (Below ground)	500 Inside Portal 44	None	---
	Odor Control Facility with Electrical Room	1,500 with 400 for electrical room	Compressor/Bubblers Carbon Scrubbers Fan Electrical Panels	2 2 2 4
Portal 19	Transition Structure (Below ground)	300	None	---
	Sampling Station (Below ground)	400	Sampling pump/ analyzer	1

Route 9-228th Street Conveyance System

The Route 9-228th Street Conveyance System Alternative would include the same Route 9 site, influent portion of the corridor, and outfall zone as the 195th Street Conveyance System Alternative. The effluent pipeline for the 228th Street Conveyance System would follow a different alignment (generally along 228th Street SE/SW in Snohomish County) than the 195th Street Conveyance System Alternative and would have a different set of effluent pipeline portal siting areas, as shown on Figure 16. An influent pump station would be located at the Route 9 plant site; because the conveyance system would be a combination of pressure pipelines and gravity system, no other pump stations would be required within the conveyance system. The majority of the Route 9-228th Street Conveyance System would be located in Snohomish County.

Affected jurisdictions for the Route 9-228th Street Conveyance System (including influent portion) could include the cities of Woodinville, Bothell, Brier, Kenmore, Lake Forest Park, Shoreline, Mountlake Terrace, Edmonds, the Town of Woodway, and unincorporated King and Snohomish Counties.

Influent Pipeline

The influent pipeline would follow the same alignment as the Route 9-195th Street Conveyance System that extends from Portal 11 in Kenmore across SR-522 then north on 68th Avenue NE to Portal 44, east along NE 195th Street through Portal 41 to SR-522, and then north to the Route 9 site. The influent characteristics would be the same as the 195th Street Conveyance System except that the influent is not contained within a combined tunnel with the effluent pipeline.

A profile of the Route 9-228th Street Conveyance System influent is shown in Figure 17.

Effluent Pipeline

The effluent portion of the 228th Street Conveyance System would follow 228th Street SE/SW from the Route 9 site passing through Portals 39, 33, and 26 to a point near the intersection of 228th Street SW and 95th Place West. The corridor then would turn south and would generally follow 100th Avenue West until intersecting with NW 205th Street. At NW 205th Street, the corridor would head west to connect to the Zone 7S outfall at Point Wells. Table 5 summarizes the 228th Street Conveyance System characteristics. A cross section of the tunnels is provided in Figure 18. The effluent tunnel profile is shown in Figure 19.

Table 5. Summary of the Conveyance Characteristics for Route 9-228th Street Conveyance System Alternative

Characteristic	Description
Construction Method	**Tunnel:** Portal siting area 11 to portal siting area 44 Portal siting area 44 to portal siting area 41 Portal siting area 41 to Route 9 plant site Portal siting area 39 to Route 9 plant site Portal siting area 39 to portal siting area 33 Portal siting area 33 to portal siting area 26 Portal siting area 26 to portal siting area 19 **Microtunnel:** North Creek Pump Station to portal siting area 41 **Open-cut Construction:** Connection between Kenmore Pump Station and Portal 11 Kenmore Local connection to Portal 11 Swamp Creek connection to Portal 44
Approximate tunnel lengths and diameters (based on peak flow of 170 mgd)	**Total Length – 20.3 miles (gravity and pressure pipes)** **Influent Total – 8.1 miles (including 1.8 miles of local connections)** From portal siting area 11 to portal siting area 44: • 1.5 miles of 14-foot diameter tunnel (10-foot inner diameter pipeline) From portal siting area 44 to Route 9 plant site: • 4.8 miles of 14-foot diameter tunnel (11-foot inner diameter pipeline) **Local Connections** North Creek Pump Station to portal siting area 41: • 0.8 mile of 72-inch diameter microtunnel Kenmore Pump Station to portal siting area 11: • 100 to 1,500 foot of 72-inch diameter influent (depends on location of the portal site) Kenmore local connection to Portal 11: • 0.5 mile of 21-inch diameter influent (open-cut or microtunnel) Swamp Creek connection to Portal 44: • 0.5 mile of 36-inch diameter influent (open-cut or microtunnel) **Effluent Total – 12.2 miles** From Route 9 plant site to portal siting area 39: • 1.9 miles of 14-foot diameter tunnel (10-foot-inner diameter effluent pipeline) From portal siting area 39 to portal siting area 26: • 6.4 miles of 14-foot diameter tunnel (10-foot inner diameter effluent pipeline) From portal siting area 26 to portal siting area 19: • 3.9 miles of 14-foot-diameter tunnel (10-foot inner diameter effluent pipeline)

Table 5. Summary of the Conveyance Characteristics for Route 9-228th Street Conveyance System Alternative (continued)

Characteristic	Description
Portal vicinities	**Primary:** Portal 11 – NE 175th Street and 68th Avenue NE Portal 44 – NE 195th Street and 80th Avenue NE Portal 41 – NE 195th Street and 120th Avenue NE Portal 39 – 228th Street SE and 31st Avenue SE Portal 33 – 228th Street SW and Locust Way Portal 26 – 228th Street SW and Lakeview Drive Portal 19 – NW 205th Street and Richmond Beach Drive NW **Secondary:** Portal 37 – 228th Street SE and 9th Avenue SE Portal 30 – 228th Street SW and 35th Avenue W Portal 24 – 228th Street SW and 95th Place W Portal 22 – NW 205th Street and 8th Avenue NW
Approximate primary portal depths	Portal 11 – 45 feet Portal 44 – 80 feet Portal 41 – 90 feet Portal 39 – 110 feet Portal 33 – 110 feet Portal 26 – 200 feet Portal 19 – 40 feet
Pipeline material	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In combined tunnel sections or where additional lining is required due to internal or external pressure, a "second-pass" lining of steel pipe, fiberglass pipe, or CIP concrete, which may include a membrane, would be used. **Microtunnel:** Reinforced concrete pipe or fiberglass pipe **Open-cut connection:** Welded steel pipe, fiberglass pipe, or reinforced concrete pipe

Portal Siting Areas

Seven primary portals would be constructed (Portals 11, 44, 41, 39, 33, 26 and 19), the deepest of which would be approximately 200 feet (Portal 26). Table 6 contains a summary of the primary portals and construction characteristics associated with the primary portals. Portal construction characteristics include: purposes of primary portals, portal construction methods, dewatering volumes, earthwork volumes removed from site (including tunnels), and construction duration at the primary portal sites.

Table 6. Summary of Portal Characteristics for Route 9-228th Street Conveyance System Alternative

Characteristic	Description
Construction purposes of primary portals	Portal 11 – TBM launch, spoils receiving, local connection to Bothell-Woodinville Interceptor and Juanita Interceptor Portal 44 – TBM launch, TBM retrieval, spoils receiving, local connection to Swamp Creek Trunk Portal 41 – TBM launch, spoils receiving, local connection to Woodinville-Bothell Sewer Interceptor, North Creek Sewer Interceptor Portal 39 – TBM launch, TBM retrieval, spoils receiving Portal 33 – TBM launch, TBM retrieval, spoils receiving Portal 26 – TBM retrieval, may be used to provide lining supplies to the tunnel following removal of the TBM Portal 19 – TBM launch, spoils receiving
Primary portal probable construction methods	Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert Portal 44 – Concrete slurry walls with a jet-grout invert slab to provide groundwater cut-off and invert stability; localized sumps will be used to de-pressurize the invert as excavation proceeds Portal 41 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert Portal 39 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert Portal 33 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert Portal 26 – Frozen earth walls (ground freezing) to 290-ft depth, local sump pump to control seepage through invert of excavation Portal 19 – Interlocking steel-sheet pile walls, with a jet grout invert plug to control seepage and provide for a stable invert. Local sump pump may also be required to de-pressurize invert

Table 6. Summary of Portal Characteristics for Route 9-228th Street Conveyance System Alternative (continued)

Characteristic	Description
Primary portal dewatering rates	Portal 11 - 20 to 80 gpm for 0.5 year of portal construction - Up to 80 gpm for 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time - Up to 50 gallons per minute (gpm) for 1 year of tunnel lining Portal 44 - 1 to 10 gpm for 0.5 year of portal construction - Up to 140 gpm for 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 110 gpm for 1 year of tunnel lining Portal 41 - 20 to 100 gpm depending on use of jet grout for 0.5 year of portal construction - Up to 100 gpm for 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time - Up to 70 gpm for 1 year of tunnel lining Portal 39 - 1 to 20 gpm for 0.5 year of portal construction - Up to 110 gpm for 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 80 gpm for 1 year of tunnel lining Portal 33 - 1 to 20 gpm for 0.5 year of portal construction - Up to 130 gpm for 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 100 gpm for 1 year of tunnel lining Portal 26 - 1 to 10 gpm for 1 year of portal construction activity Portal 19 - 1 to 10 gpm for 0.5 year of portal construction - Up to 140 gpm for 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 110 gpm for 1 year of tunnel lining
Primary portal earthwork volumes	Total: 53,000 yd^3 Portal 11 – 4,000 yd^3 Portal 44 – 9,000 yd^3 Portal 41 – 8,000 yd^3 Portal 39 – 11,000 yd^3 Portal 33 – 10,000 yd^3 Portal 26 – 7,000 yd^3 Portal 19 – 4,000 yd^3
Tunnel earthwork volumes	Overall total: 696,000 yd^3 Reach 11-44 – 10,000 yd^3 Reach 44-41 – 96,000 yd^3 Reach 41-TP – 94,000 yd^3 Reach TP-39 – 75,000 yd^3 Reach 39-33 – 116,000 yd^3 Reach 33-26 – 135,000 yd^3 Reach 26-19 – 112,000 yd^3

Table 7 summarizes the portal candidate sites for each of the portal siting areas. Candidate site information includes site size and access roads that would likely be used to access the site. The candidate sites are shown in the Figures contained in Attachment C.

Table 7. Summary of Portal Candidate Sites for Route 9-228th Conveyance System Alternative

Portal	Candidate Sites	Size (Acres)	Access Roads
Primary Portals			
11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	68th Avenue NE / Juanita Drive NE 175th Street SR-522 (Bothell Way)
44	Site 44-C Site 44-D Site 44-E	3.6 8.8 2.3	SR-522 (Bothell Way) 80th Avenue NE NE 195th Street
41	Site 41-A Site 41-C Site 41-D Site 41-X Site 41-W Site 41-J	6.7 16.1 4.6 5.1 3.3 3.7	I-405 NE 195th Street 120th Avenue NE North Creek Parkway Beardslee Boulevard
39	Site E39-B Site E97-C Site E39-D	2.9 2.3 2.2	228th Street SW Bothell Everett Highway
33	Site E33-A Site E33-C Site E33-D	2.7 3.0 3.0	SR-527 228th Street SW Locust Way
26	Site E26-A Site E26-C Site E26-D	3.0 8.9 4.4	SR-104 (Ballinger Way NE) SR-99 224th Street SW 73rd Avenue W 228th Street SW
19	Site E19-A Site E19-C Site E19-E	1.9 8.5 3.4	SR-99 N 185th Street Fremont Avenue NW Richmond Beach Road NW 195th Street NW 196th Street Richmond Beach Drive
Secondary Portals			
22	Site E22-A Site E22-C Site E22-D Site E22-E Site E22-F	3.1 3.3 2.2 2.4 1.5	SR-104 (Ballinger Way NE) 244th Street SW 100th Avenue W / 8th Avenue NW NW 200th Street 10th Avenue NW (Firdale Avenue)
24	Site E24-A Site E24-B Site E24-C	2.4 2.1 2.2	SR-104 (Edmonds Way) 95th Place W 228th Street SW
30	Site E30-A Site E30-B Site E30-C	2.5 2.0 4.9	SR-104 (Edmonds Way) 236th Street SW Cedar Way 35th Avenue W 228th Street SW

Table 7. Summary of Portal Candidate Sites for Route 9-228th Conveyance System Alternative (continued)

Portal	Candidate Sites	Size (Acres)	Access Roads
Secondary Portals			
37	Site E37-A Site E37-C Site E37-D	2.7 2.7 4.5	SR-527 228th Street SW 9th Avenue SE 19th Avenue SE

Permanent Facilities

Permanent facilities would be located at portal sites for the 228th Street Conveyance System Alternative. A summary of the permanent facilities is shown in Table 8. These facilities would be similar to those discussed for the Route 9–195th Street Conveyance System.

Table 8. Summary of Permanent Facilities at Portal Sites for Route 9-228th Conveyance System Alternative

Facility	Structures	Size (sq.ft.)	Equipment	Quantity
Portal 11	Drop Structure (Below ground)	Inside Portal 11	None	---
	Odor Control Facility with Electrical Room	1,500 with 400 for electrical room	Compressor/Bubblers Carbon Scrubbers Fan Electrical Panels	2 2 2 4
Kenmore Pump Station	Chemical Injection Facility	Use existing at Kenmore Pump Station	Use existing (reroute piping)	---
	Diversion Structure (below ground at Kenmore Pump Station)	500	72-in Slide Gates/ Actuators	3
Portal 41	Drop Structure (below ground)	Inside Portal 41	None	---
	Odor Control Area with Electrical Room	2,000 with 400 for electrical room	Chemical Scrubber Carbon Scrubber Fan Electrical Panels	1 1 2 4
North Creek Pump Station	Chemical Injection at North Creek Pump Station	Reuse existing plus 400 for second tank	7,000 gal Tank/Pump	1
	Diversion Structure (below ground)	500 at North Creek Pump Station	72-in Slide Gates Compressor/Bubbler	3 1
Portal 44	Drop Structure (Below ground)	Inside Portal 44	None	---
	Odor Control Facility with Electrical Room	1,500 400	Compressor/Bubblers Carbon Scrubbers Fan Electrical Panels	2 2 2 4

Table 8. Summary of Permanent Facilities at Portal Sites for Route 9-228th Conveyance System Alternative (continued)

Facility	Structures	Size (sq.ft.)	Equipment	Quantity
Portal 26	Odor Control Facility with Electrical Room	1,000 with 400 for electrical room	Passive Carbon or Biofilter Electrical Panels	1 3
	Dechlorination Facility	1,200	Tank/Metering Pump	1
	Transition Structure (Below ground)	300	None	---
Portal 19	Transition Structure (Below ground)	300	None	1
	Sampling Station (Below ground)	400	Sampling Pump/Analyzer	1

Unocal Conveyance System

The Unocal Conveyance System would include a treatment plant located at the Unocal site in the City of Edmonds, and an influent pipeline to carry wastewater from King County's existing pipelines in Bothell and Kenmore to the Unocal site (See Figure 20). Because the treatment plant would be located adjacent to Puget Sound and the outfall zone, the Unocal Conveyance System effluent would be conveyed directly to the outfall.

The Unocal Conveyance System would begin in the vicinity of the existing North Creek Pump Station at Portal 14 immediately northeast of the SR-522 and I-405 interchange, and would generally follow a straight cross-country path (under private right-of-way) to the existing Kenmore Pump Station (Portal 11). From Portal 11, the corridor would generally follow SR-522 (Bothell Way NE), and then turns northwest along SR-104 (Ballinger Way NE) through Portal 7. The corridor would follow SR-104 (Ballinger Way NE) and after crossing I-5 near NE 205th Street, continue west along NE 205th Street towards SR-104 (Edmonds Way), then generally follow SR-104 (Edmonds Way) through Portal 3 to the Unocal site. The approximate length of the corridor would be 11.6 miles, most of which would be in King County.

The conveyance system would be a gravity system between Portal 14 and Portal 11. A new pump station near the existing Kenmore Pump Station at Portal 11 would be required to pump the wastewater uphill to Portal 7. The tunnel would be constructed at a grade that roughly follows the ground surface between Portals 11 and 7, thereby minimizing the required depths for the portals. The conveyance system would convert back to a gravity system between Portal 7 and the Unocal site. An influent and effluent pump station would be required on the Unocal site.

The depth of the influent tunnel would range from approximately 40 to 350 feet. A profile of the influent tunnel is shown in Figure 22. See Figure 21 for a cross section of the tunnels. Specific elements of the Unocal Conveyance System are shown in Table 9.

Table 9. Summary of Conveyance Characteristics for Unocal Conveyance System Alternative

Characteristic	Description
Construction Method	**Tunnel:** Portal siting area 14 to portal siting area 11 Portal siting area 11 to portal siting area 7 Portal siting area 7 to portal siting area 3 Portal siting area 3 to Unocal site **Microtunnel:** North Creek Pump Station to portal siting area 14 **Open-cut Construction or Microtunnel:** Connection between Kenmore Pump Station and Portal 11
Approximate tunnel lengths and diameters (based on peak flow of 170 mgd)	**Total Influent Length – 11.6 miles (excluding local connections) (gravity and force mains)** From portal siting area 14 to portal siting area 11: • 3.4 miles of 16-foot diameter tunnel (12.5-foot inner diameter pipeline) From portal siting area 11 to portal siting area 7: • 3.2 miles of 14-foot diameter tunnel (48- and 54-inch inner diameter force mains) From portal siting area 7 to portal siting area 3: • 2.9 miles of 16-foot diameter tunnel (12.5-foot inner diameter pipeline) From portal siting area 3 to Unocal site: • 2.1 miles of 16-foot diameter tunnel (12.5-foot inner diameter pipeline) **Local Connections:** Kenmore Pump Station to portal siting area 11: • 100 to 1,500 feet of 72-inch diameter influent (depends on location of the portal site) North Creek Pump Station to portal siting area 14: • 100 to 1,500 feet of 60-inch diameter influent (depends on location of the portal site) Kenmore local connection to portal siting area 11: • 0.5 miles of 21-inch diameter influent (open-cut or microtunnel)
Portal vicinities	**Primary:** Portal 14 – North Creek Parkway and 120th Avenue NE Portal 11 – NE 175th Street and 68th Avenue NE Portal 7 – Ballinger Way NE and 25th Avenue NE Portal 3 – SR-104 and 232nd Street SW **Secondary:** Portal 13 – Bothell Way NE and Woodinville Drive Portal 12 – NE 183rd Street and 80th Avenue NE Portal 10 – NE 178th Street and 44th Avenue NE Portal 5 – NE 205th Street and Ballinger Way NE
Approximate primary portal depths	Portal 14 – 50 feet Portal 11 – 60 feet Portal 7 – 120 feet Portal 3 – 280 feet

Table 9. Summary of Conveyance Characteristics for Unocal Conveyance System Alternative (continued)

Characteristic	Description
Pipeline material	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In tunnel sections where additional lining is required due to internal or external pressure, a “second-pass” lining of steel pipe, fiberglass pipe, or CIP concrete, which may include a membrane, would be used. **Open-cut connection:** Welded steel pipe, fiberglass pipe, or reinforced concrete pipe

Unocal Conveyance System Portal Siting Areas

The Unocal Conveyance System would include primary and secondary portal sites. Four primary portals would be constructed (Portals 14, 11, 3, and 7), the deepest of which would be approximately 280 feet (Portal 3). Table 10 contains a summary of the primary portals and construction characteristics associated with the primary portals. Primary portal construction characteristics include: purposes of primary portals, portal construction methods, dewatering volumes, earthwork volumes removed from site (including tunnels), and construction duration at the primary portal sites.

Table 10. Summary of Portal Characteristics for Unocal Conveyance System Alternative

Characteristic	Description
Construction purposes of primary portals	Portal 14 – TBM retrieval, local connection to Bothell-Woodinville Interceptor and North Creek Sewer Interceptor Portal 11 – TBM launch, spoils receiving, local connection to Swamp Creek Trunk, Bothell-Woodinville Interceptor, and Juanita Interceptor Portal 7 – TBM launch, TBM retrieval, spoils receiving Portal 3 – TBM retrieval
Primary portal probable construction methods	Portal 14 - Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert Portal 7 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert Portal 3 – Frozen earth walls (ground freezing) to 290 ft. depth, local sump pump to control seepage through invert of excavation

Table 10. Summary of Portal Characteristics for Unocal Conveyance System Alternative (continued)

Characteristic	Description
Primary portal dewatering rates	Portal 14 - 20 to 80 gpm for 1 year of portal construction activity Portal 11 - 0 to 20 gpm for 0.5 year of portal construction - Up to 120 gpm for 1.5 years of tunnel excavation, and up to 250 gpm for four 2-week periods during this time - Up to 90 gpm for 1.5 years of tunnel lining Portal 7 - 1 to 10 gpm for 0.5 year of portal construction - Up to 110 gpm for 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time - Up to 80 gpm for 1 year of tunnel lining Portal 3 20 to 50 gpm for 1 year of portal construction activity
Primary portal earthwork volumes	Total: 29,000 yd^3 Portal 14 – 2,000 yd^3 Portal 11 – 6,000 yd^3 Portal 7 – 11,000 yd^3 Portal 3 – 10,000 yd^3
Tunnel earthwork volumes	Overall total: 554,000 yd^3 Reach 14-11 – 174,000 yd^3 Reach 11-7 – 125,000 yd^3 Reach 7-3 – 148,000 yd^3 Reach 3-TP – 107,000 yd^3

Table 11 summarizes the portal candidate sites for each of the portal siting areas. Candidate site information includes site size and access roads that would likely be used to access the site. The candidate sites are shown in the Figures contained in Attachment C.

Table 11. Summary of Portal Candidate Sites for Unocal Conveyance System Alternative

Portal	Candidate Sites	Size (Acres)	Access Roads
Primary Portals			
3	Site I3-D Site I3-E Site I3-F	1.9 2.3 2.0	SR-104 (Edmonds Way) 92nd Avenue W 232nd Street SW
7	Site I7-A Site I7-B Site I7-C	9.0 2.9 4.5	I-5 SR-104 (Ballinger Road NE) 25th Ave. NE
11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	68th Avenue NE/Juanita Drive NE 175th Street SR-522 (Bothell Way)

Table 11. Summary of Portal Candidate Sites for Unocal Conveyance System Alternative

Portal	Candidate Sites	Size (Acres)	Access Roads
14	Site I14-A Site I14-B Site I14-D	4.0 3.7 3.2	Inbound: NE 195th Street North Creek Parkway 120th Avenue NE Outbound: NE 180th Street 132nd Avenue NE SR-522 (Bothell Way)
Secondary Portals			
5	Site I5-B Site I5-G1 Site I5-X	3.3 1.8 1.0	SR-104 (Ballinger Road NE) 15th Avenue NE
10	Site I10-A Site I10-C Site I10-D SiteI10-E	5.6 3.8 4.0 2.1	SR-522 (Bothell Way) 44th Avenue NE SR-104 (Ballinger Way NE) NE 178th Street Brookside Boulevard NE
12	Site I12-C Site I12-E	3.1 2.1	SR-522 (NE Bothell Way) 175th Street NE 73rd Avenue NE
13	Site I13-A Site I13-B Site I13-C	2.0 3.0 2.7	SR-522 (Bothell Way) Woodinville Drive

New Kenmore Pump Station

A new pump station would be required if the Unocal site is selected. The pump station would be located in the vicinity of Portal 11 near the site of the existing Kenmore Pump Station. The influent pump station would be sized for 170 mgd. The pump station would contain the following functional components:

- Basic mechanical and electrical pumping equipment
- Odor control equipment
- Standby power generation equipment and fuel storage
- Chemical feed equipment and chemical storage

The footprint of the new Kenmore Pump Station was developed from a review of existing King County pump stations for purposes of estimating general site requirements. The footprint is intended to be conservative and allow for systems likely to be included in the final design. Specific details and configurations may change.

The overall dimension of the pump station structure shown in Figure 23 is approximately 200 feet by 90 feet. Setbacks from adjacent properties, turning areas and parking for operations and maintenance vehicles, and planting spaces were incorporated into the overall site. A 45-foot minimum setback from adjoining properties was assumed along with a 65-foot minimum setback from the street frontage. Specific setbacks may vary slightly from these. An overall site of approximately 290 feet by 200 feet would be required for the entire facility. The height of the building would vary based on final architectural finishes but could range from 20 feet to as high as 35 feet.

Specific, available pumping equipment was identified to meet the hydraulic requirements when developing the pump station layout. The number and size of pumps would be selected based on conventional pumps available from a variety of manufacturers. Design flow conditions were examined for the various conveyance piping configurations. A total of six pumping units are shown for the pump station. Because this pump station would be a critical facility, a seventh pump may be provided to handle peak flow conditions in the event that another pump fails.

Mechanical/electrical space requirement would be determined from selected pump sizes and allowing five feet between pumping units. Mechanical spacing width would be allowed for piping, stairways, and maintenance. Additional building length would be allowed for a self-cleaning wet well. A 10-foot wide platform would be provided for wet well access for inspection and maintenance.

Standby power generation equipment would be diesel powered, and fuel would be provided from above-grade storage. The new Kenmore Pump Station would require four 2,000 kW generator units. Additional space would be needed for acoustic louvers for commercial site locations and for sound traps.

Permanent Facilities

Permanent facilities would be located at portal sites for the Unocal Conveyance System Alternative. A summary of the permanent facilities is shown in Table 12.

Table 12. Summary of Permanent Facilities at Portal Sites for Unocal Conveyance System Alternative

Facility	Structures	Size (sq.ft.)	Equipment	Quantity
Portal 14	Drop Structure	Inside Portal 14	None	-
North Creek Pump Station	Odor Control Area	Reuse existing North Creek PS Odor Contol System	Chemical Scrubber/Carbon Bed Fan	2 2
	Chemical Injection Facility	Upgrade Existing	Add 7,000 gallon tank/pump	1
Portal 11	New Pump Station	18,000	Pumps and associated equipment	---
	Drop Structure	Inside Portal 11	None	---
	Odor Control Facility with Electrical Room	4,000 with 400 for electrical room	Carbon Beds Fan Electrical Panels	2 2 4
Kenmore Pump Station	Chemical Injection Facility	Upgrade Existing	Add 7,000-gallon tank/pump	1
	Diversion Structure	500	78-in Slide Gates Compressor/Bubblers	2 2

Table 12. Summary of Permanent Facilities at Portal Sites for Unocal Conveyance System Alternative (continued)

Facility	Structures	Size (sq.ft.)	Equipment	Quantity
Portal 7	Odor Control Facility with Electrical Room	3,000 with 400 for electrical room	Bioscrubber/Chemical Scrubber/Carbon Bed Fan Electrical Panels	2 2 4
	Force Main Discharge Structure	Inside Portal 7	None	---

Construction Schedule

Approximate construction time for the tunnels would range from one to four years. This time period reflects the range of tunnel lengths, depths, and lining designs currently being considered. For example, for a 10,000-foot-long, 150-foot-deep tunnel, and a two-pass lining (this involves an additional activity, over and above the excavation/initial lining phase, whereby a second lining [pipeline or force main] is installed inside the lined tunnel), the construction time would be approximately 32 months (2.7 years). For a 20,000-foot-long tunnel of the same depth and lining type, the construction time would likely be 65 months (5.4 years). Much of the conveyance construction would be at the portals. Estimated periods of construction activities have been determined for each of the following portal locations:

195th Street Alternative

Portal 11: 2.0 - 2.5 years
Portal 44: 3.5 - 4.0 years
Portal 41: 3.0 years
Portal 5: 1.0 year
Portal 19: 3.5 - 4.0 years

228th Street Alternative

Portal 11: 2.0 - 2.5 years
Portal 44: 3.0 - 3.5 years
Portal 41: 2.5 - 3.0 years
Portal 39: 3.0 years
Portal 33: 3.0 - 3.5 years
Portal 26: 1.0 year
Portal 19: 3.5 years

Unocal Alternative

Portal 14: 1.0 year
Portal 11: 3.5 - 4.0 years
Portal 7: 3.0 years
Portal 3: 1.0 year

Operations and Maintenance Requirements

Operation and maintenance requirements for the various types of facilities included in the conveyance system are provided below. Chemical handling for the permanent facilities is also discussed in this section.

Hydraulic Control Structures

Hydraulic control structures such as drop and diversion structures would require approximately one maintenance visit per month to ensure that no vandalism has occurred to the facility. This visit could include a two-person crew in a County truck. On a semiannual basis, a three- to five-person crew could conduct an internal inspection to check for corrosion. The inspection could last up to eight hours, depending on the types of conditions found. During the semiannual maintenance, slide gates within drop and diversion structures would be exercised and otherwise maintained according to manufacturer's recommendations.

For each visit that requires removal of the structure lift slab (expected to be two times per year), one boom truck or crane with driver would be used, and depending on the weight of the lift slab, an additional two vehicles and drivers may be required.

Gate valve maintenance falls into two categories - routine maintenance and response (breakdown) maintenance. Routine maintenance or preventative maintenance involves checking the control valves on a predefined schedule to perform inspections, cleanings, lubrications, adjustments, replacements, etc. Mechanical issues are addressed during preventative maintenance. A two-person crew would handle routine maintenance in approximately one to two hours, while any programmable maintenance (recommended by the equipment manufacturer) could take four to five hours. If forced-air equipment were required, the routine maintenance would have an additional few hours added to properly ventilate facilities. This would use a generator and blower to ventilate as required.

Pump Stations

Pump stations would be serviced at least two times per week for up to five hours. A two- to four-person crew using a County truck would visit the facility for maintenance. The visit could include the following indoor activities:

- Verify and correct alarms.
- Run any required tests.
- Check proper operating modes of equipment.
- Determine if there are any mechanical problems.
- Check main control panel (alarm panel lights, tests, wet well level recorder, equipment hour meter readings, and pump mode).
- Verify settings of level controllers, and check lockout/tag out (tags and keys match equipment locked out).
- Monthly, semiannual, and programmable annual visits would be required, again using a two- to four-person crew. Pump replacement does not require any additional equipment or staff than routine or programmable maintenance.

Odor Control and Chemical Injection Facilities

Odor control facilities would consist of either liquid-phase treatment at chemical injection facilities or vapor-phase treatment at air handling facilities. In general, a two-person crew using a truck would check that the system is performing adequately two times per week. These visits would last approximately one to two hours. Additional maintenance would be required as described below for the specific type of odor control used. Preventive maintenance would be focused on cleaning the filter and spray nozzles, as needed, checking the electrical components, sampling to ensure required treatment levels, and checking pumps and float switches for proper operation. Monthly visits would take from two to four hours.

If carbon is used as the filter medium, it should be changed at least one to two times per year, depending on the loading rates and design criteria. One vector truck, one boom truck, one flatbed truck (each with a driver), two to three additional vehicles, and three additional maintenance staff would be needed to complete filter replacement. Weekly, monthly, and semiannual maintenance would be performed to ensure proper operation of the facility.

A non-biodegradable biofilter medium normally does not require cleaning or changing because the life span of the filter is 20 to 30 years. A small intermittent septic pump would be inspected. No sludge would be produced to pump out because of the unique aerobic anoxic trickle filter process. Daily maintenance would include checking proper operation of fans, opening drain lines to release collected moisture, recording differential pressure across the fans, and inspecting the water flow into the filter.

If a wet scrubber were used, routine maintenance visits would be required approximately two times per week. Weekly preventative maintenance would include checking pump and fan motor, looking for leaks, checking for proper operation of dampers, and checking chemical metering pumps and probes. Monthly, quarterly, and semiannual maintenance would be performed to ensure proper operation of the facility.

Chemical injection facility chemicals would include iron salts, calcium nitrate, or sodium hypochlorite. Chemical storage would require a standard-size tank for approximately a two-week supply of chemicals. Therefore, one truck delivery would be required every two weeks. Maintenance personnel would handle routine maintenance and system applications.

Dechlorination Facility

Dechlorination chemical, sodium bisulfite, would be delivered from a semi-truck into a storage tank as needed and this would be a four- to six-hour operation. In addition to the two-times-per week maintenance visits by a two-person crew, weekly and monthly visits would be required. Routine visits could range from two to five hours.

Sampling Station

The sampling station would contain a sampling pump and an automated analyzer system. Online analyzers would be used to acquire sampling data. Routine maintenance visits would occur once per week, or every other week, to inspect the proper operation of the pump with a two-person crew for about one to two hours. Effluent samples would also be obtained on a weekly or biweekly basis.

Chemical Handling and Storage

Chemicals would be stored and distributed for odor control, chemical injection and dechlorination facilities. Odor control chemicals, if scrubbers were used, would be hypochlorite. Chemical injection chemicals could include iron salts, calcium nitrate, and sodium hypochlorite. Dechlorination involves the addition of sodium bisulfite to the effluent.

Chemical injection odor control and dechlorination chemicals would be delivered by truck and stored onsite in bulk storage tanks. All chemical storage and handling would be designed to comply with the applicable local, state, and federal regulations, such as the Uniform Fire Code (UFC), Resource Conservation and Recovery Act (RCRA), and OSHA. Most of the chemicals would be delivered and stored onsite in solution form. The onsite storage would provide approximately 15 to 30 days storage capacity for each chemical. The tanks would be designed with high and low level indicators to allow continuous feed; tanks would have containment and safety provisions in accordance with all applicable requirements. The buildings would be provided with appropriate ventilation and alarm systems in case of emergency.

Safety Relief Point

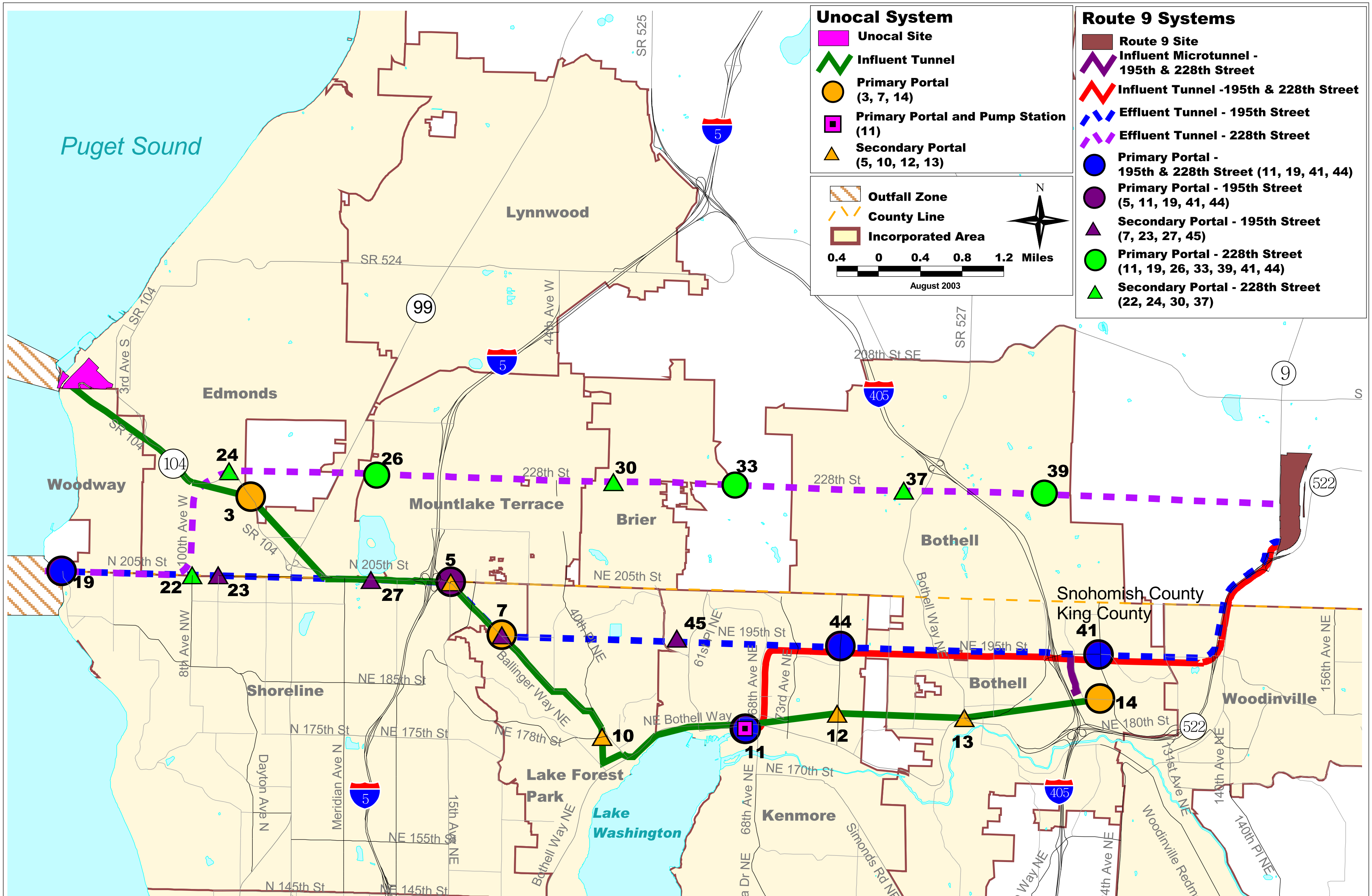
To avoid having untreated wastewater overflow from the conveyance system during extreme or prolonged wet weather conditions and multiple equipment failure scenarios, the flow management strategies listed in the Handling Emergency Overflows section would be implemented to avoid or minimize any potential SSO. However, if all available flow management strategies were implemented and flows in the conveyance system continued to exceed the capacity of the treatment plant (or the plant was unable to accept flows), then an SSO could occur at a safety relief point in the conveyance system located in the Kenmore area. The purpose of the proposed safety relief point is to provide a fixed location where overflows can be monitored as opposed to multiple unmonitored locations along the Sammamish River. Construction of a safety relief structure would enable operators to protect the conveyance system during unusual combinations of events (such as pump station failures during large storms) by diverting flows directly into the Sammamish River. Diversion of an SSO to the Sammamish River (at a single point rather than multiple uncontrolled points) would provide more rapid dilution of the discharge and eliminate the potential for the discharge to affect isolated or small waterbodies and minimize potential effects to human health.

The safety relief point would be located in Kenmore, east of the 68th Avenue NE Bridge north of the Sammamish River (Figure 4). The underground facility would consist of a structure (adjacent to the existing King County 78-inch diameter Bothell-Kenmore Interceptor) and dual 72-inch pipes leading from the structure to an underwater discharge point at the north bank of the Sammamish River. The underwater discharge would eliminate the land impacts of previous overflow discharges, in which wastewater flowed across private property, roads, wetlands, and riparian buffers before entering the Sammamish River and Lake Washington. In addition, an underwater discharge would provide a greater volume of water for dilution to further minimize potential impacts.

The control structure would be a two-chamber concrete vault, approximately 28 feet by 32 feet. One chamber would be situated over the existing Kenmore Interceptor. The second chamber would be separated from the first by a weir. This chamber would be constantly full with river water. The bottom of the weir would be located six inches above the maximum water surface elevation in the Sammamish River to prevent river water from entering the conveyance system.

If the influent tunnel and other existing storage facilities are filled and flow diversions are initiated, but flows into the conveyance continue to exceed the capacity of the Brightwater system, wastewater would begin surcharging throughout the conveyance system, including the Kenmore Interceptor. Once the Kenmore Interceptor is surcharged to a height equal to the weir elevation, the stormwater-diluted wastewater would spill over the weir by gravity into the second chamber and flow out through the dual 72-inch pipes to the Sammamish River. The second chamber would contain instrumentation that would send an alarm to the King County conveyance system control center and calculate the approximate volume of wastewater exiting the conveyance system.

Each pipe would be terminated with a screen to prevent fish and objects in the Sammamish River from entering the pipes. The pipelines would be cut at an angle to avoid obstructing the river and the crown of the discharge pipes would be a minimum of two feet below the lowest low water elevation in the Sammamish River. Pipe material would be reinforced concrete, fiberglass reinforced plastic, ductile iron, or high-density polyethylene. Installation would involve open cut construction in the riverbank.



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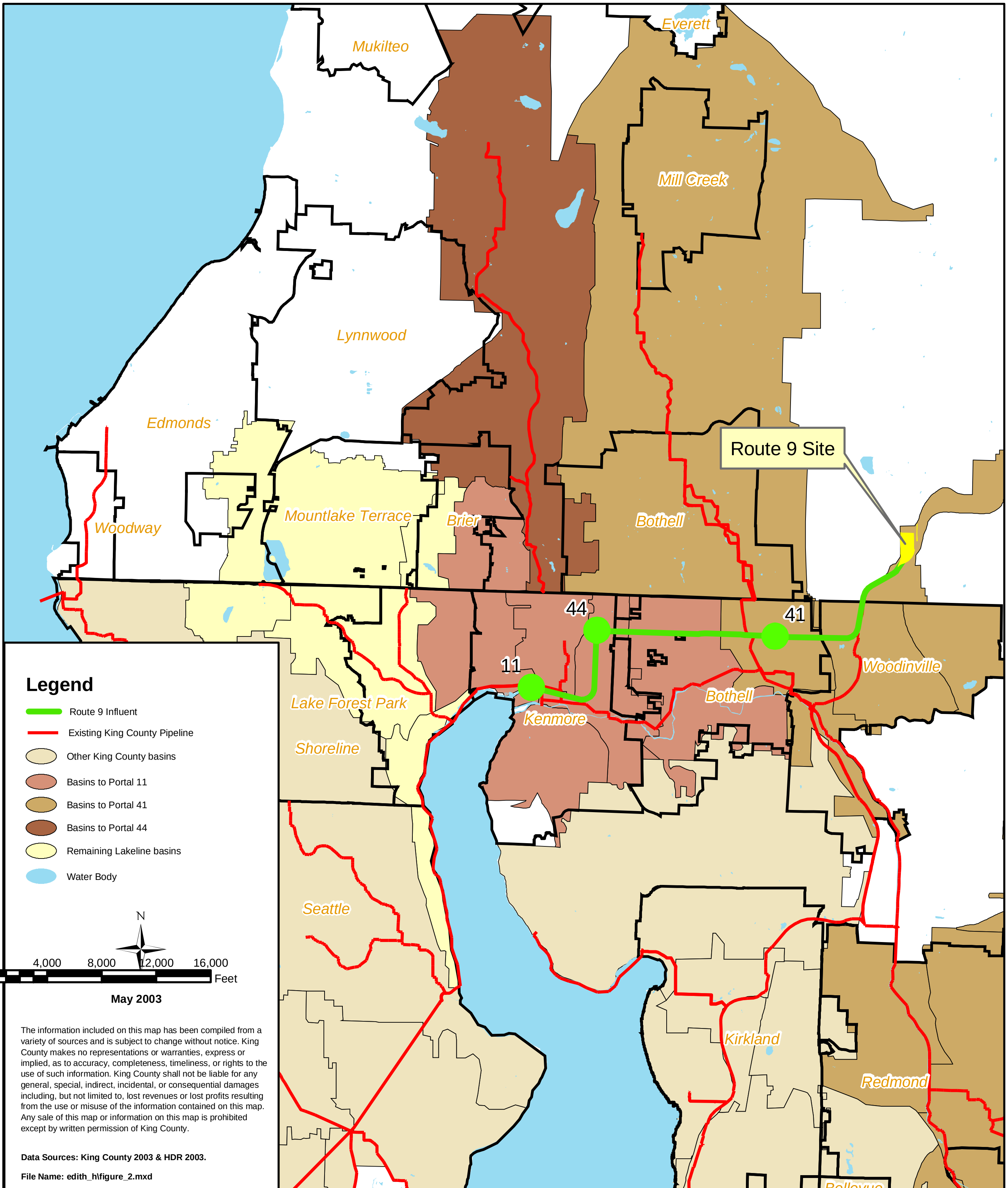
Prepared by: King County WTD GIS

Figure 1

Alternative Corridors

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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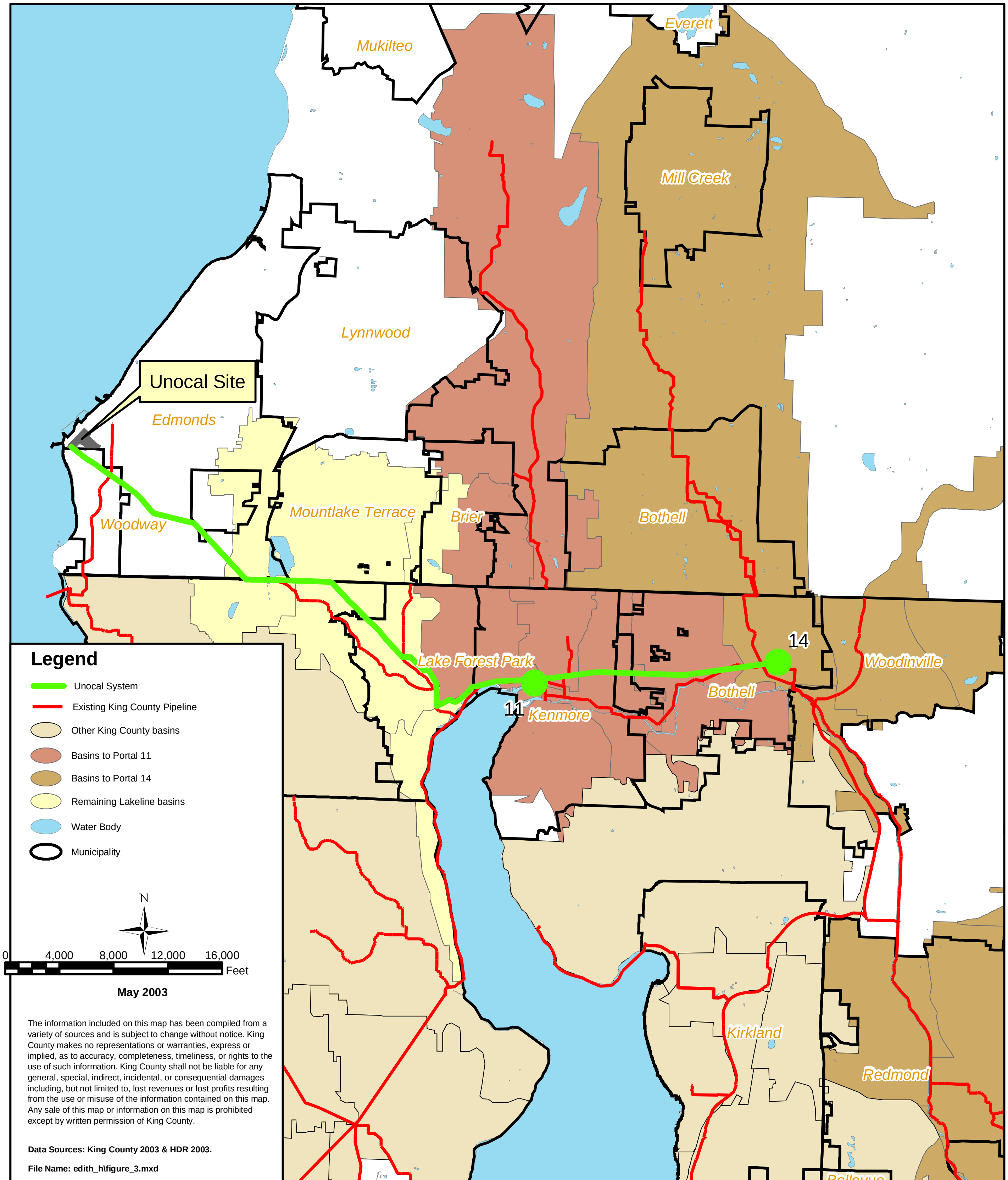
Note: King County is proceeding with preliminary plans and designs for the Brightwater proposal. This ongoing preliminary work will not limit the choice of reasonable alternatives to be selected at the end of the EIS process.

Figure 2

Route 9 Basin Flows

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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Note: King County is proceeding with preliminary plans and designs for the Brightwater proposal. This ongoing preliminary work will not limit the choice of reasonable alternatives to be selected at the end of the EIS process.

Figure 3

Unocal Basin Flows

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

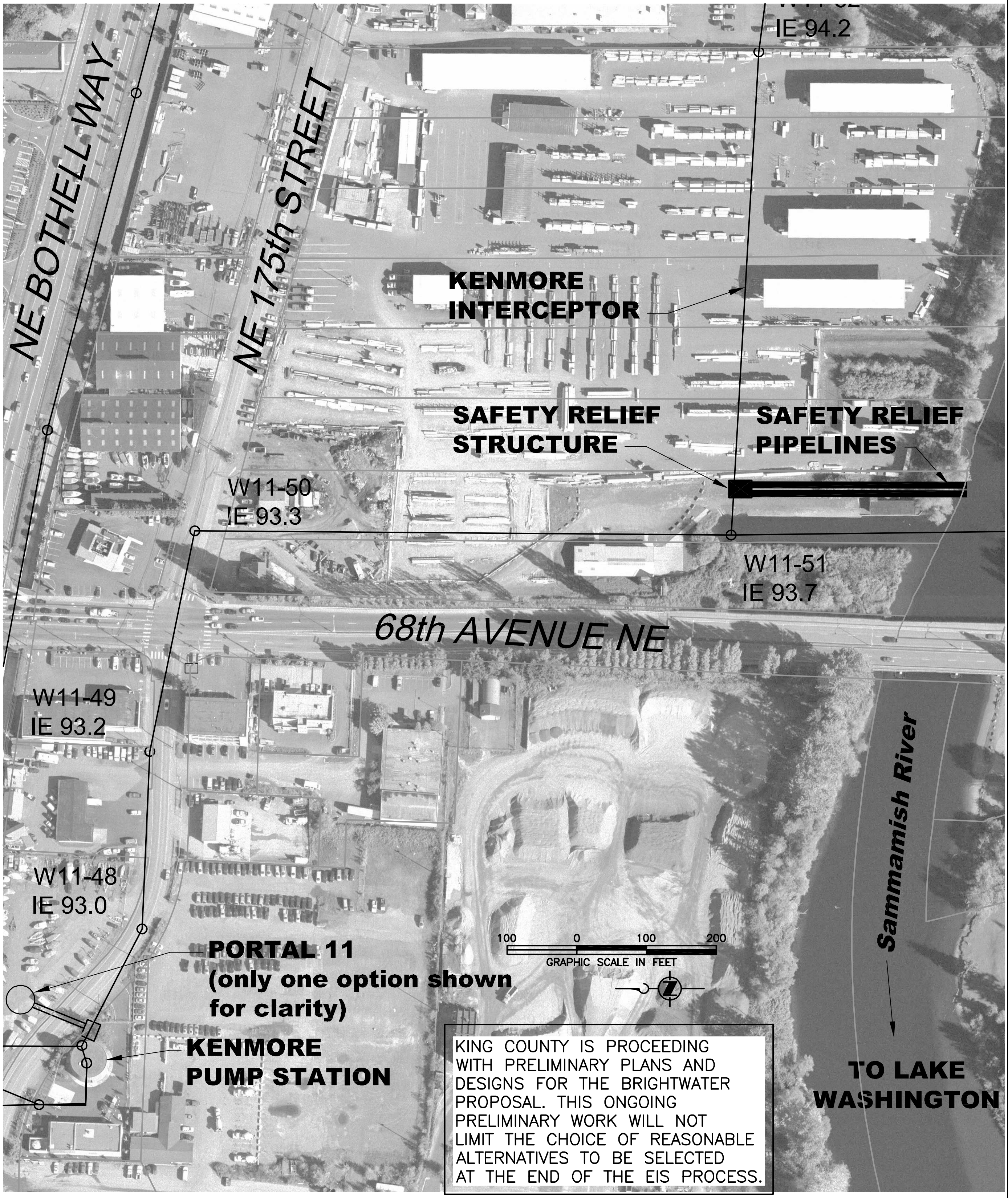

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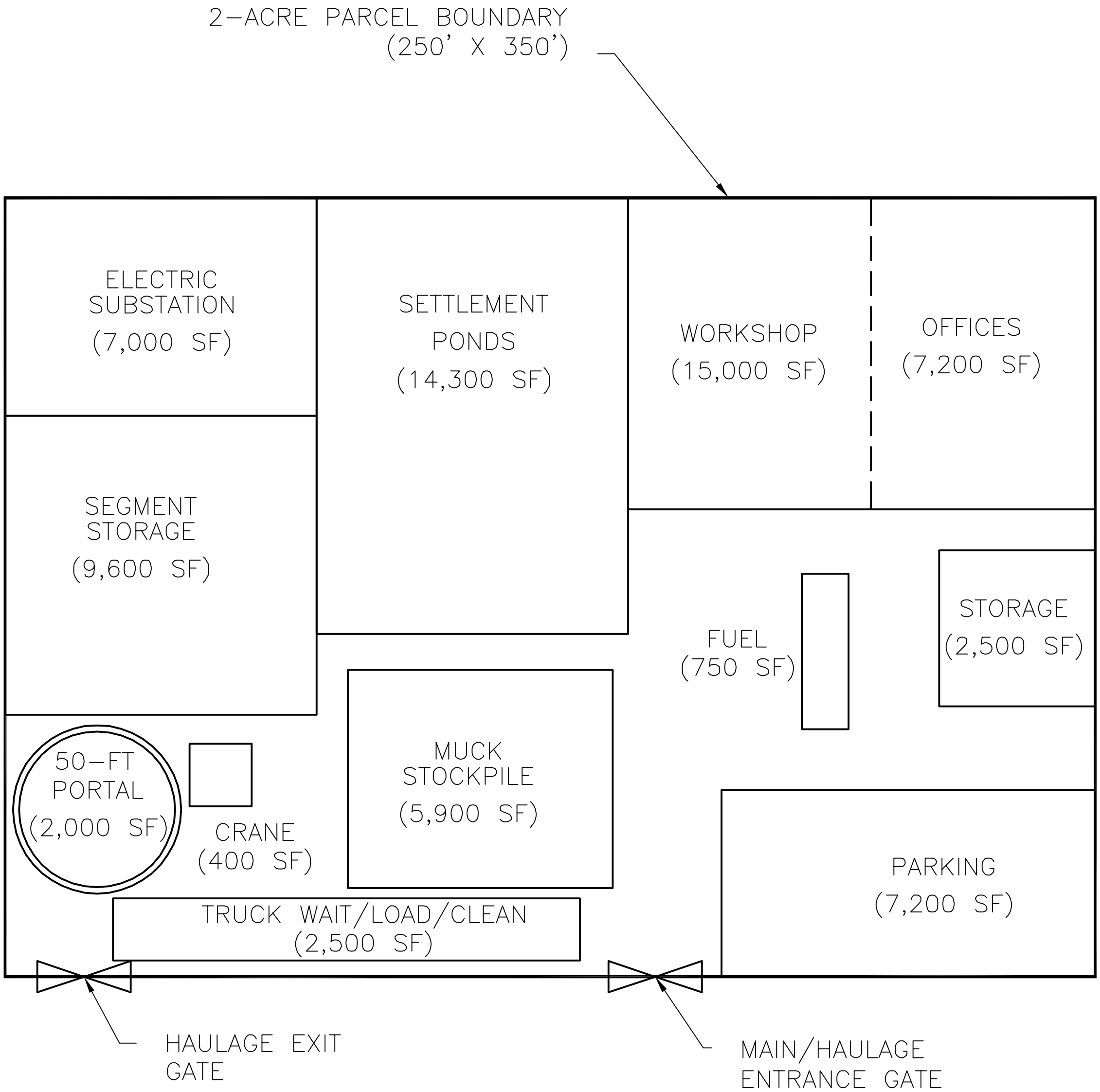
Figure 4

SAFETY RELIEF POINT

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



TYPICAL LAUNCH PORTAL SITE LAYOUT
(2-ACRE MINIMUM)

NOTE:

THE PARCEL AND EQUIPMENT LAYOUT SHOWN ABOVE IS SCHEMATIC ONLY AND DOES NOT APPLY TO ANY SINGLE PORTAL LOCATION ON THE BRIGHTWATER PROJECT.

THE EQUIPMENT AND APPROX. SQUARE FOOTAGE SHOWN ABOVE WOULD BE REQUIRED AS A MINIMUM AT ANY LAUNCH PORTAL ON THE BRIGHTWATER PROJECT; HOWEVER, ACTUAL ARRANGEMENTS AND INDIVIDUAL LAYOUTS WOULD VARY PER LOCATION.

AS SHOWN, THE COMBINED REQUIRED EQUIPMENT AND FACILITY SQUARE FOOTAGE IS APPROXIMATELY 67,200 SF. AN ADDITIONAL 30% (MINIMUM) WOULD BE REQUIRED TO ALLOW FOR MOVEMENT AROUND THE SITE, BRINGING THE TOTAL MINIMUM SQUARE FOOTAGE REQUIRED FOR A TYPICAL LAUNCH SHAFT SITE TO 87,360 SF, OR APPROXIMATELY 2 ACRES.

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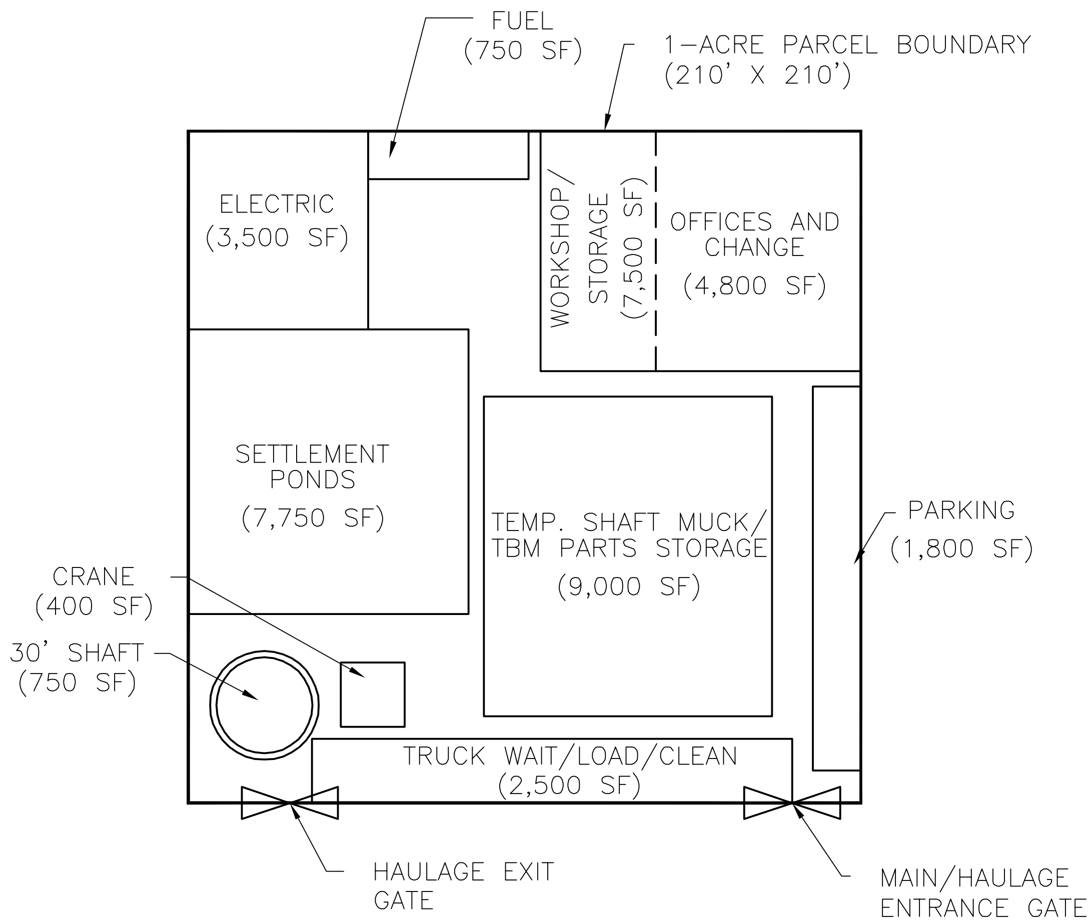
Figure 5

TYPICAL WORKING PORTAL EQUIPMENT LAYOUT

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



TYPICAL RETRIEVAL PORTAL SITE LAYOUT
(1–ACRE MINIMUM)

NOTE:

THE PARCEL AND EQUIPMENT LAYOUT SHOWN ABOVE IS SCHEMATIC ONLY AND DOES NOT APPLY TO ANY SINGLE PORTAL LOCATION ON THE BRIGHTWATER PROJECT.

THE EQUIPMENT AND APPROX. SQUARE FOOTAGE SHOWN ABOVE WOULD BE REQUIRED AS A MINIMUM AT ANY RETRIEVAL PORTAL ON THE BRIGHTWATER PROJECT; HOWEVER, ACTUAL ARRANGEMENTS AND INDIVIDUAL LAYOUTS WOULD VARY PER LOCATION.

AS SHOWN, THE COMBINED REQUIRED EQUIPMENT AND FACILITY SQUARE FOOTAGE IS APPROXIMATELY 33,950 SF. AN ADDITIONAL 30% (MINIMUM) WOULD BE REQUIRED TO ALLOW FOR MOVEMENT AROUND THE SITE, BRINGING THE TOTAL MINIMUM SQUARE FOOTAGE REQUIRED FOR A TYPICAL RETRIEVAL SHAFT SITE TO 44,135 SF, OR APPROXIMATELY 1 ACRE.

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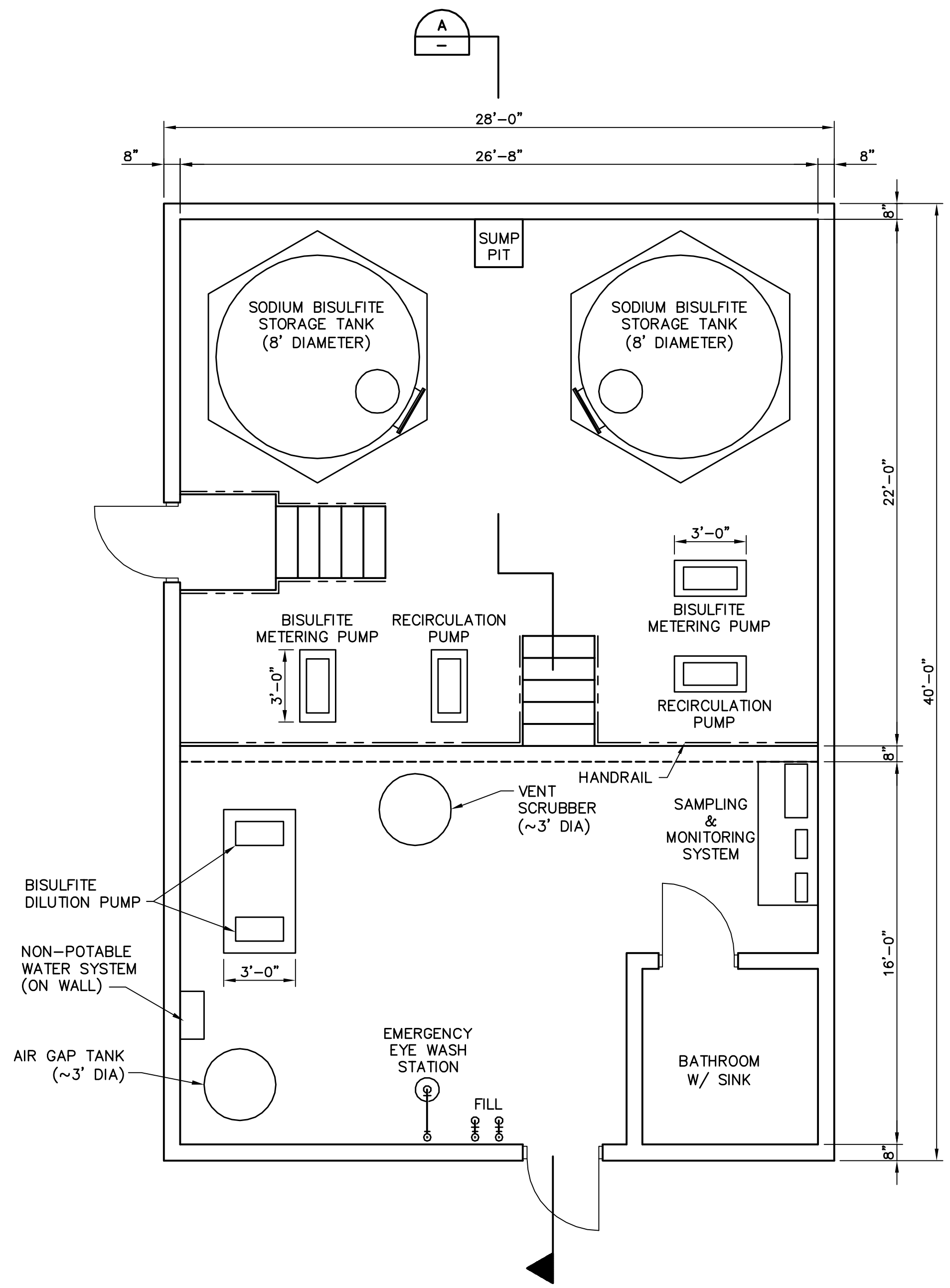
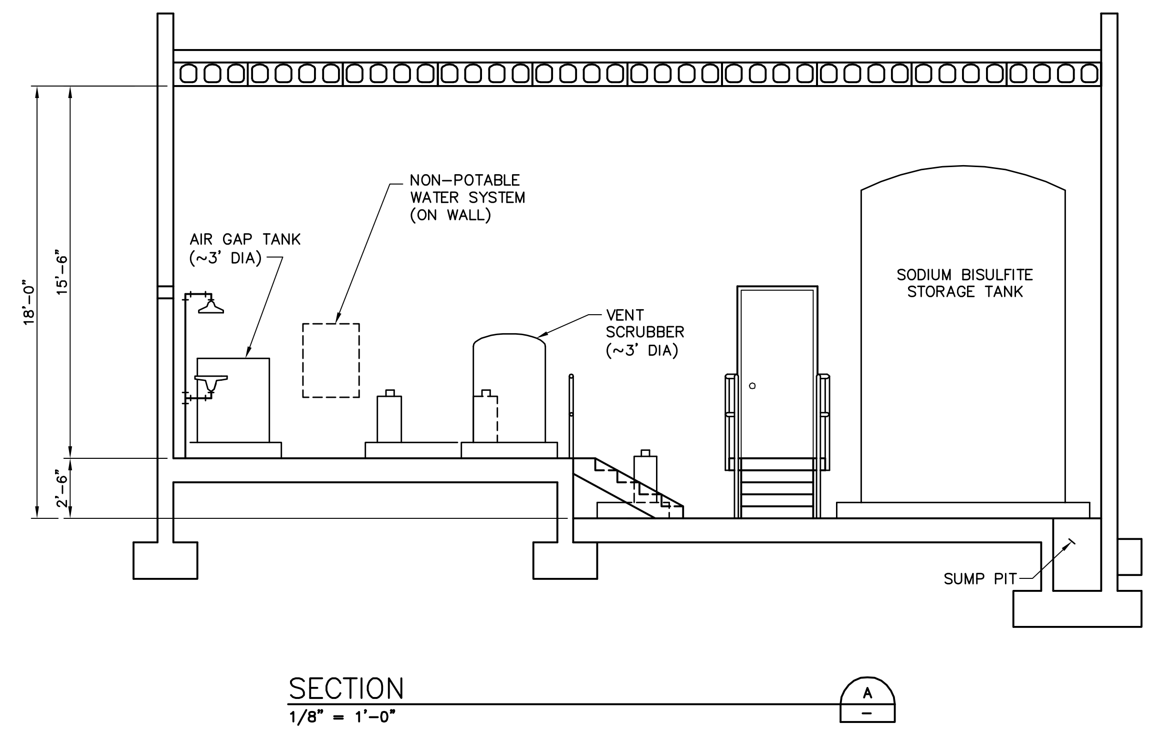
Figure 6

TYPICAL RETRIEVAL PORTAL EQUIPMENT LAYOUT

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



PLAN OF SODIUM BISULFITE FACILITY
1/8" = 1'-0"



SECTION
1/8" = 1'-0"

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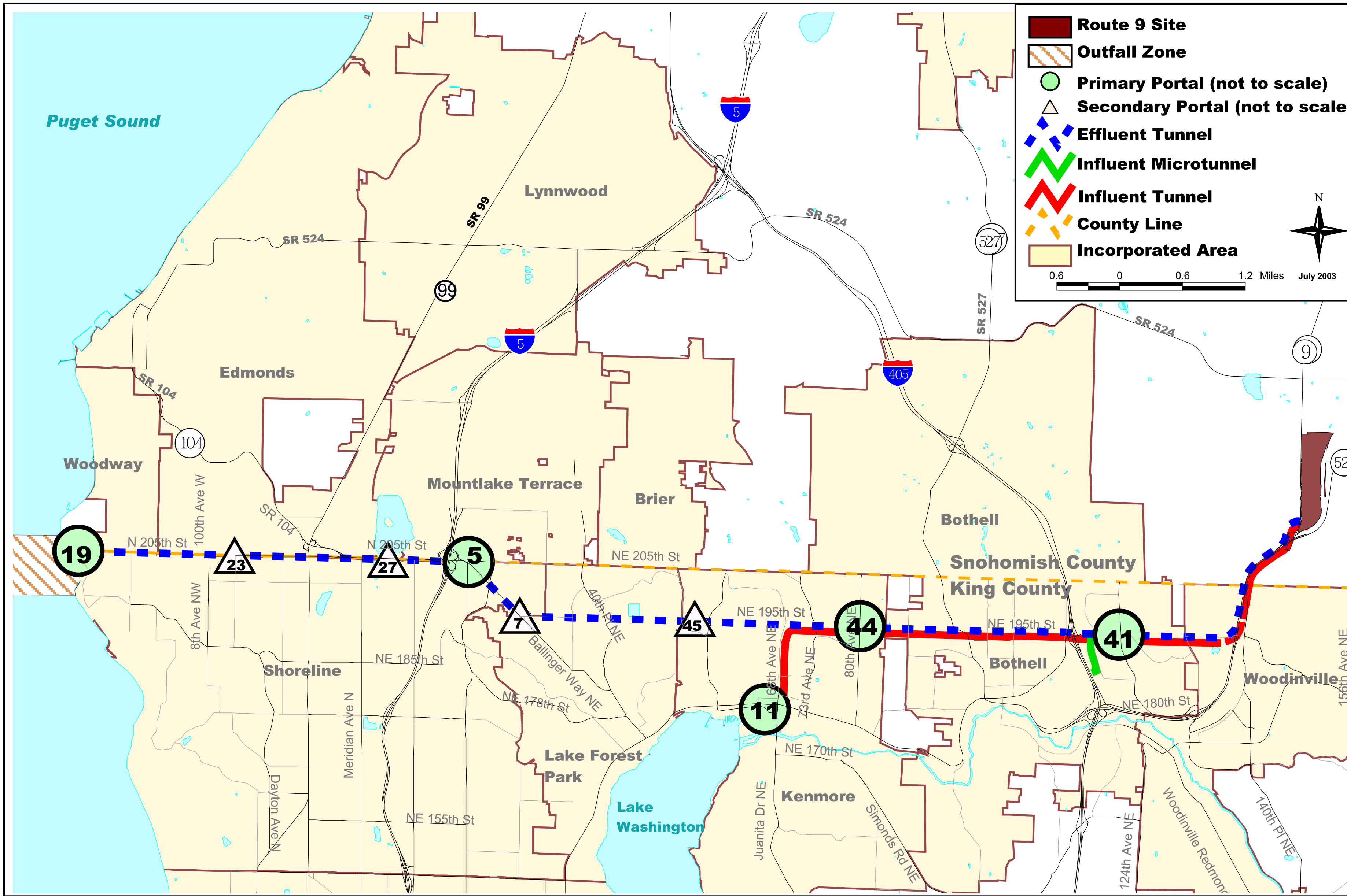
Figure 7

DECHLORINATION FACILITY

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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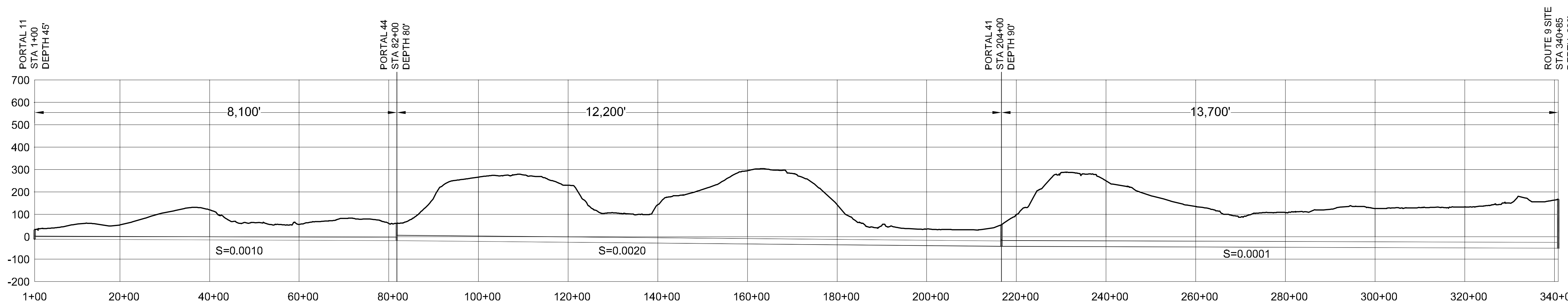
Data Source: King County
File Name: dnrp1:\\wtd\projects\bw_feis\projects \feis_regional_wtsystem.apr

Prepared by: King County WTD GIS

Figure 8

Route 9 - 195th Street Corridor (Preferred)

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



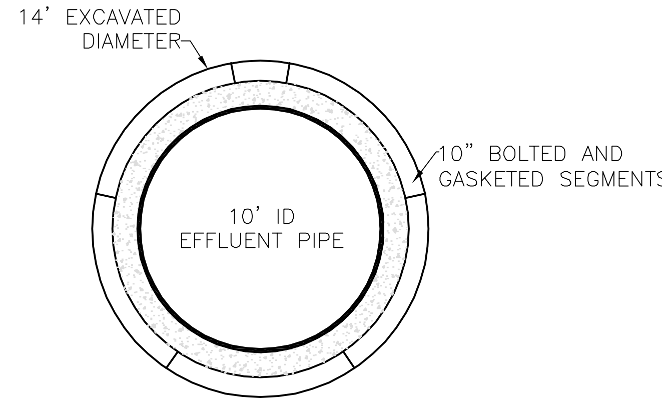
PROFILE

File Name: 195_Inf.dwg

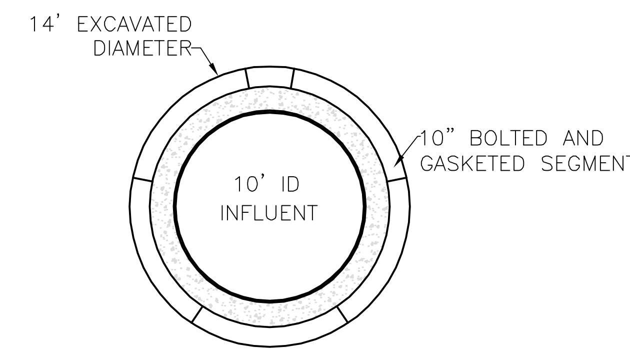
Figure 9

ROUTE 9 - 195TH ALTERNATIVE INFLUENT TUNNEL PROFILE

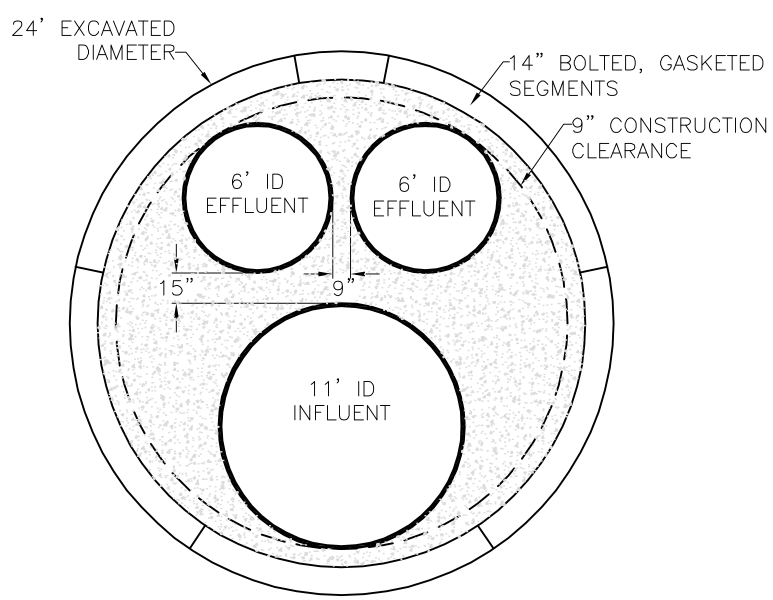
BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



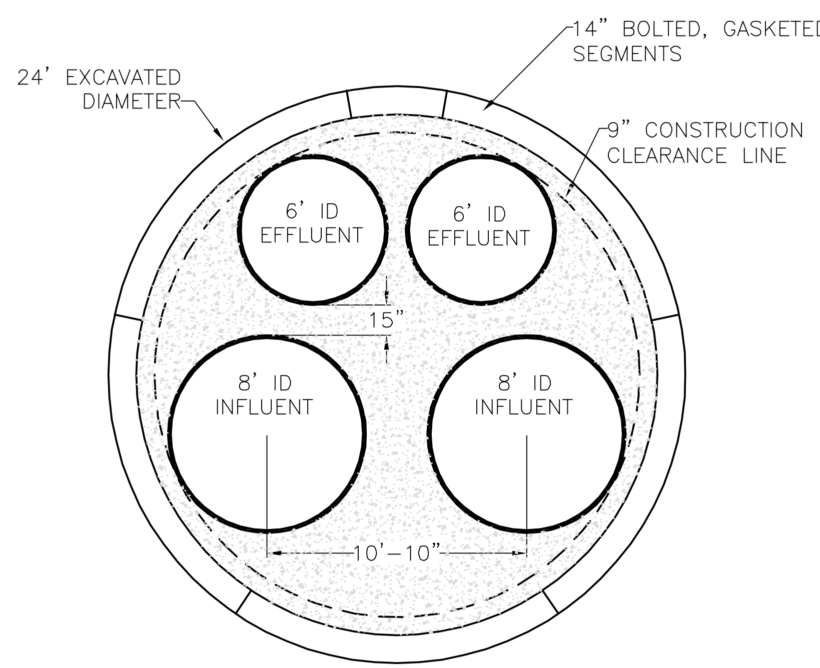
PORTAL 44 TO PORTAL 5
PORTAL 5 TO PORTAL 19



PORTAL 11 TO PORTAL 44



PORTAL 44 TO PORTAL 41



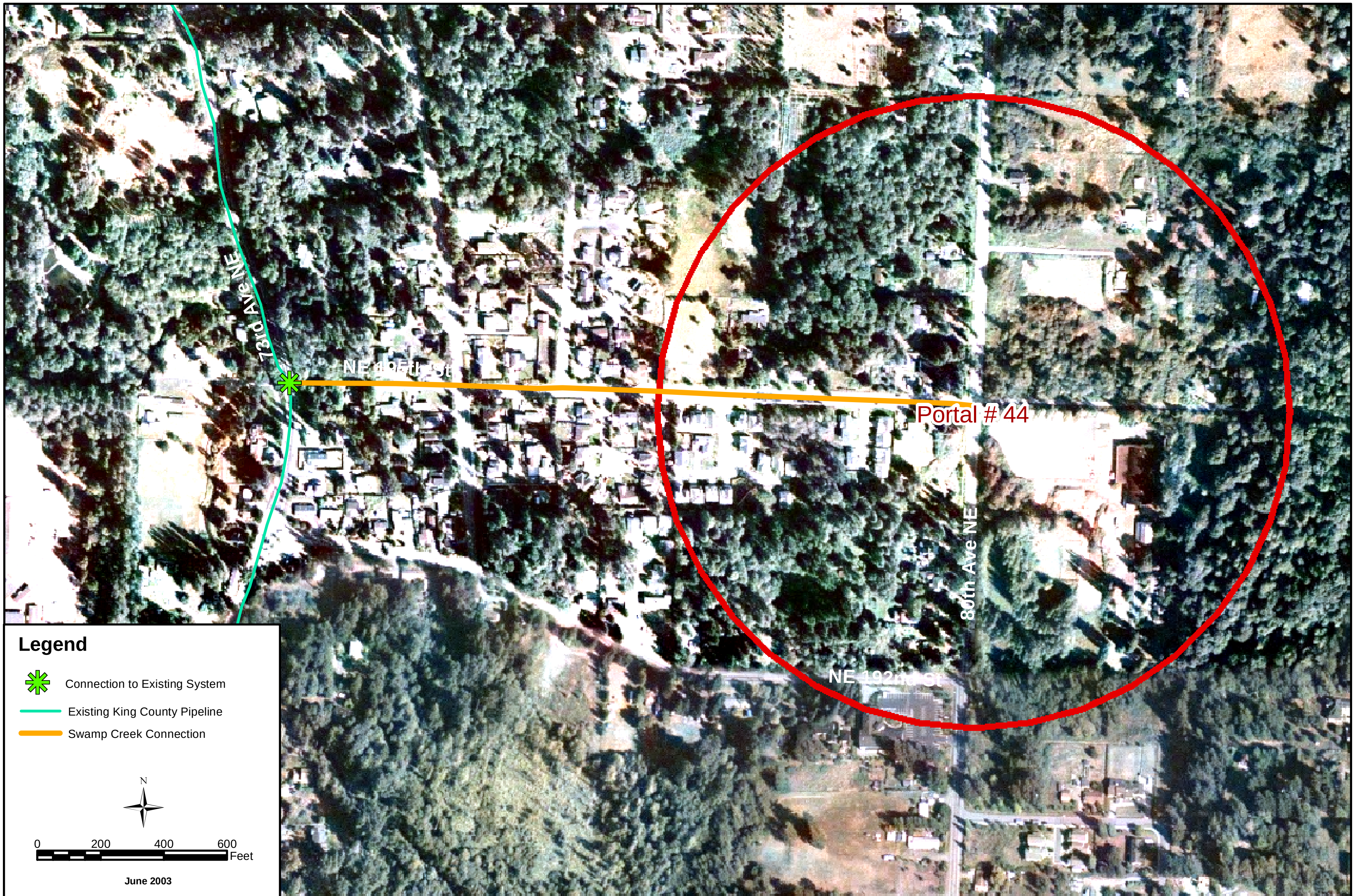
PORTAL 41 TO ROUTE 9 SITE

File Name: Cross_Sections21.dwg

Figure 10

ROUTE 9 - 195TH ALTERNATIVE TUNNEL CROSS SECTIONS

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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Wastewater Treatment
Division

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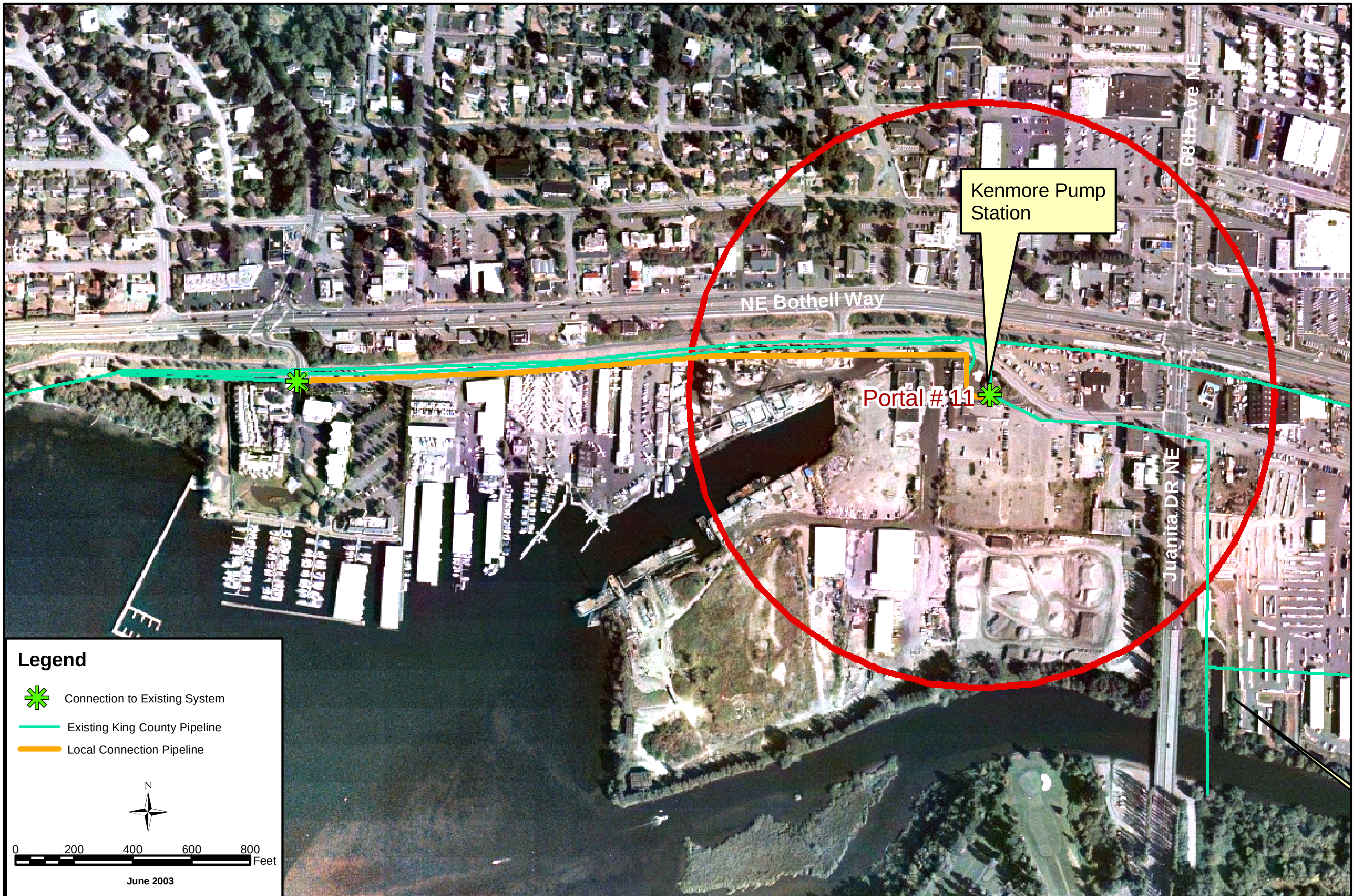
Data Sources: King County 2003 & HDR 2003.

File Name: birol_s\swamp_creek_trunk_connection.mxd

Note: King County is proceeding with preliminary plans and designs for the Brightwater proposal. This ongoing preliminary work will not limit the choice of reasonable alternatives to be selected at the end of the EIS process.

Figure 11
Swamp Creek Trunk Connection
BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



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Data Sources: King County 2003 & HDR 2003.

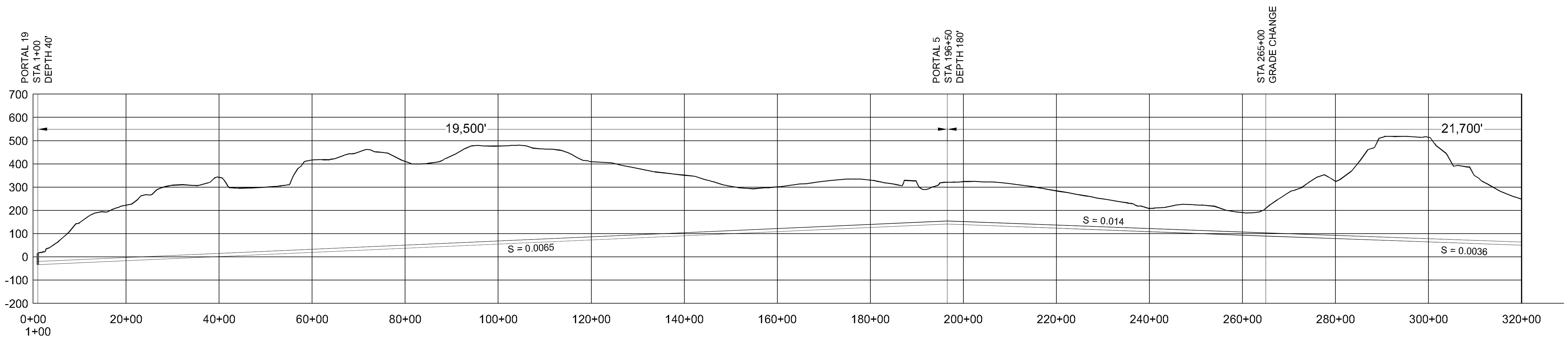
File Name: birol_s\kenmore_local_connection.mxd

Note: King County is proceeding with preliminary plans and designs for the Brightwater proposal. This ongoing preliminary work will not limit the choice of reasonable alternatives to be selected at the end of the EIS process.

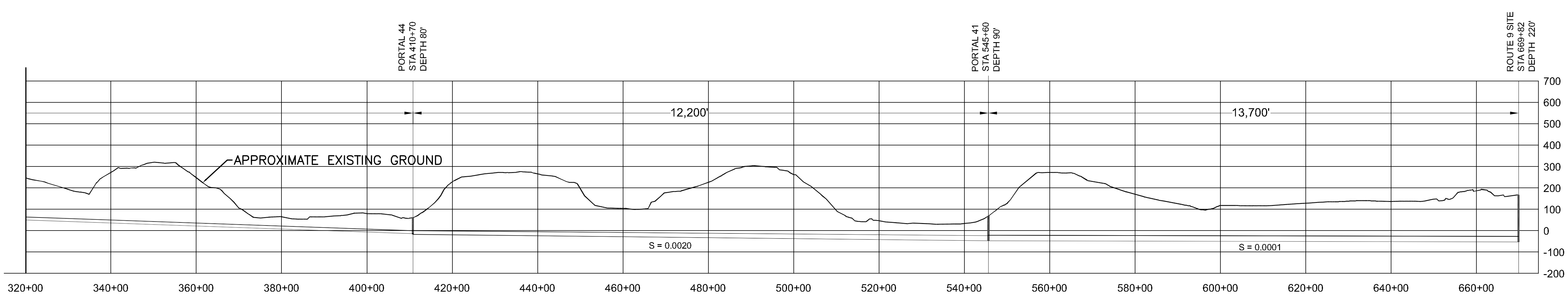
Figure 12

Kenmore Local Connection

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



PROFILE



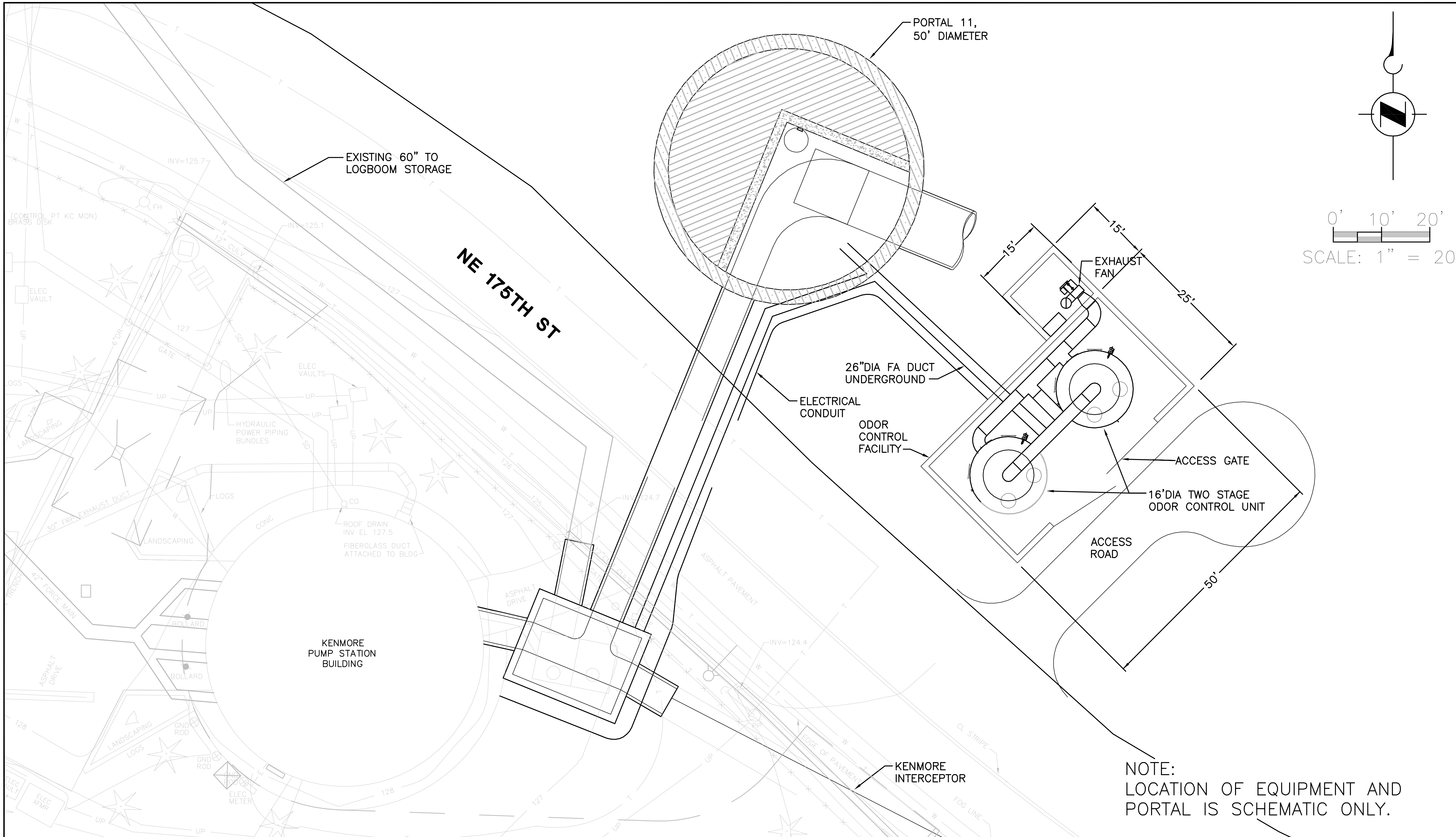
PROFILE

File Name: 195_Eff.dwg

Figure 13

ROURE 9 - 195TH ALTERNATIVE EFFLUENT TUNNEL PROFILE

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

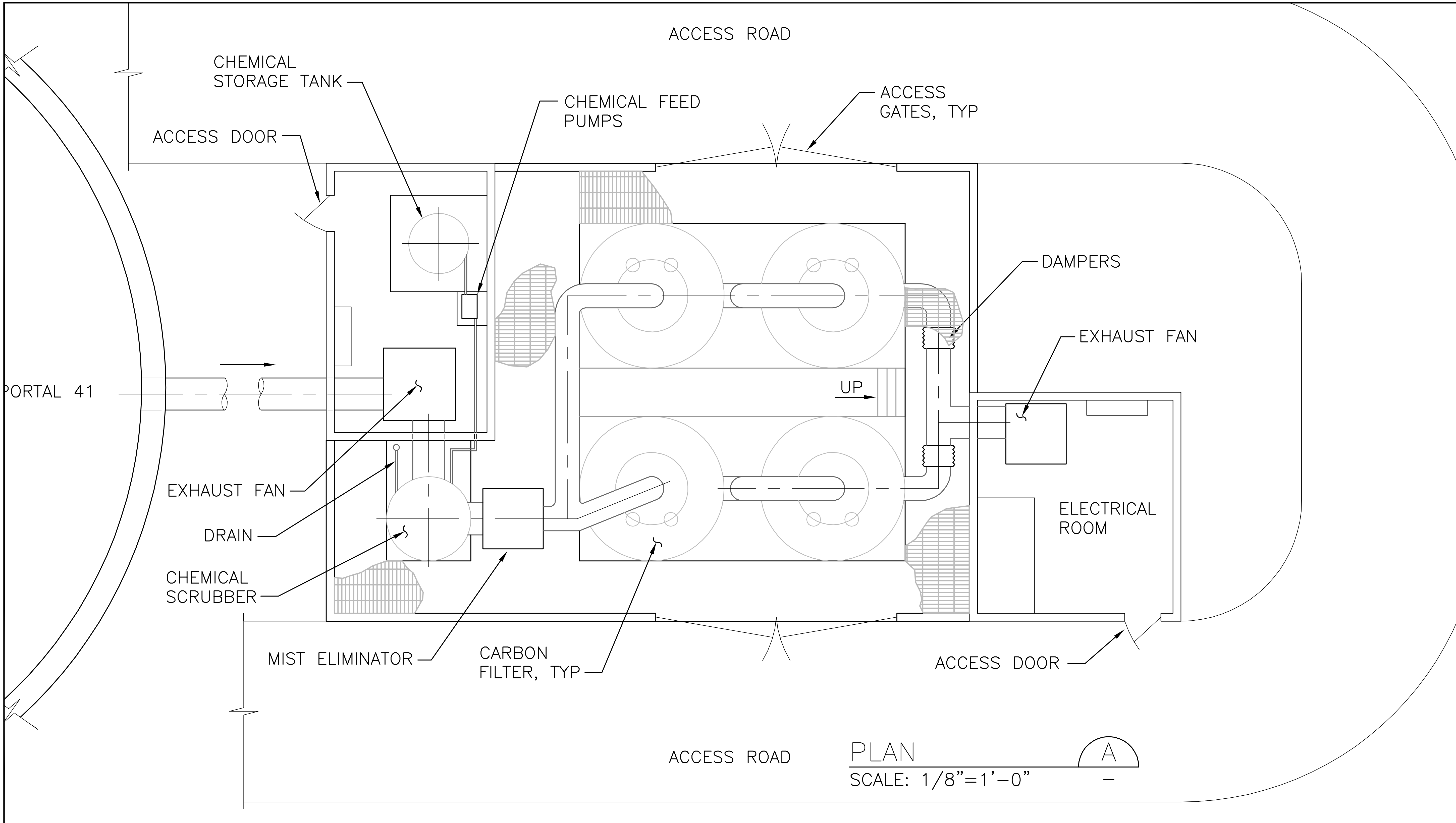


File Name: figure 33.dwg

Figure 14

PORTAL 11 - ODOR CONTROL LAYOUT

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



File Name: figure 34.dwg

Figure 15

PORTAL 41 - ODOR CONTROL LAYOUT

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

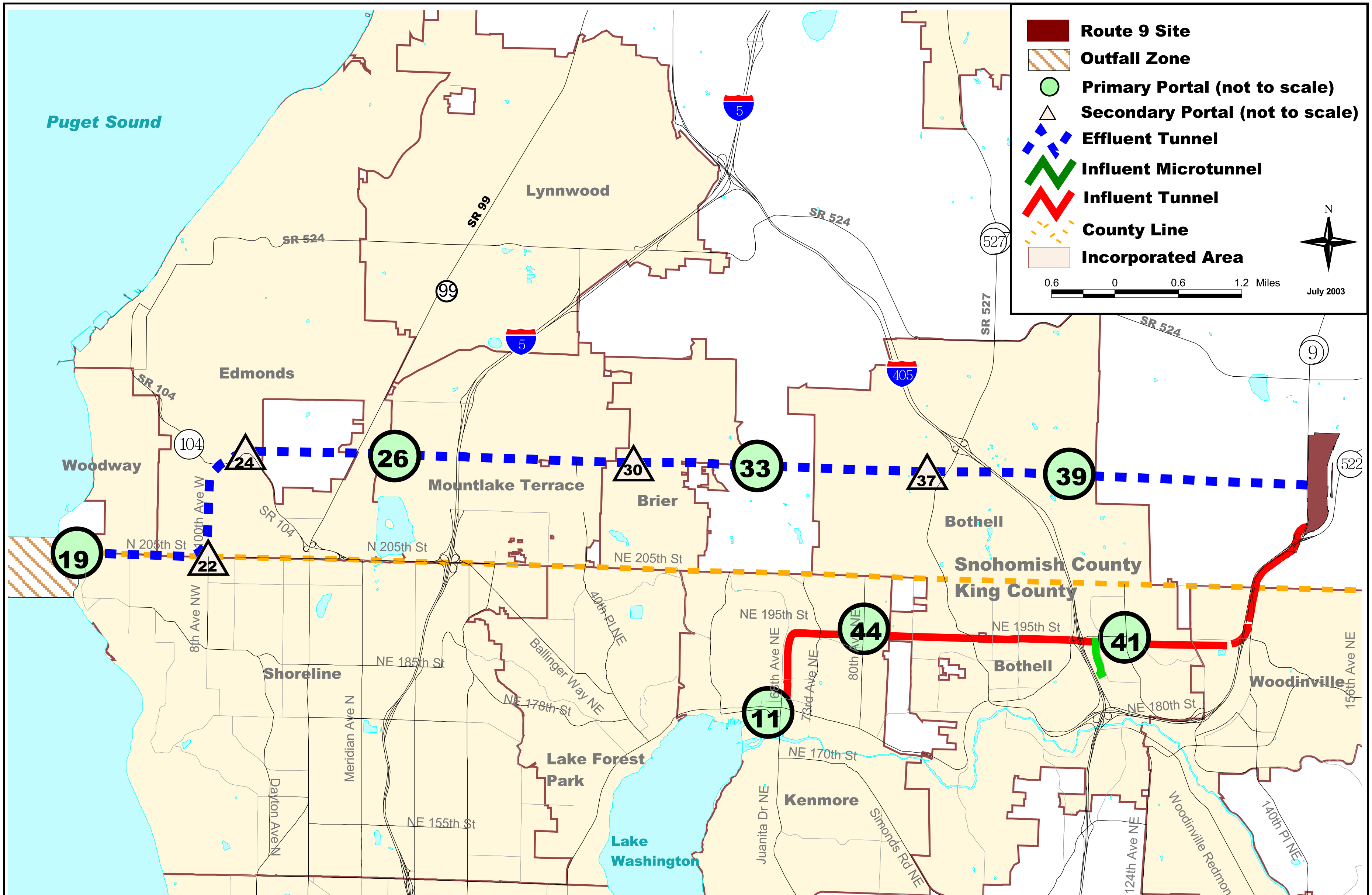


Figure 16

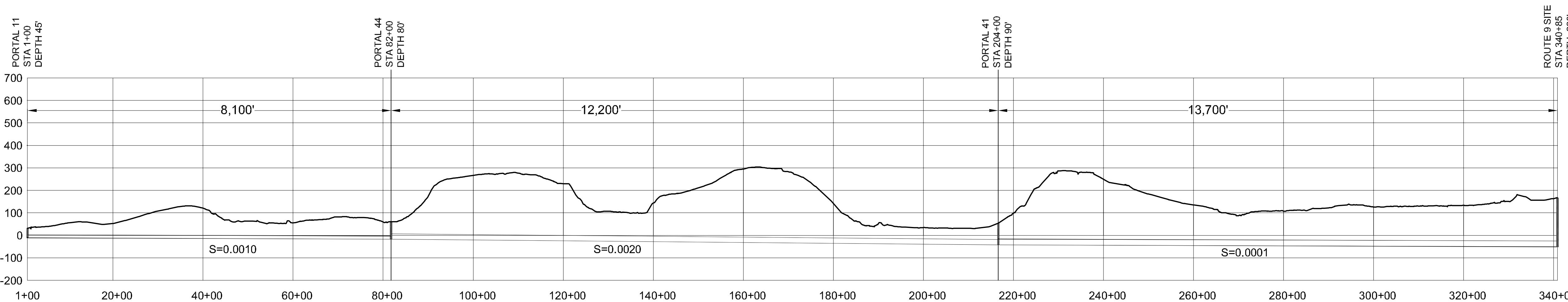
Route 9 - 228th Street Corridor

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County
File Name: dnrp1:\\wtd\projects\bw_feis\projects \feis_regional_wtsystem.apr

Prepared by: King County WTD GIS

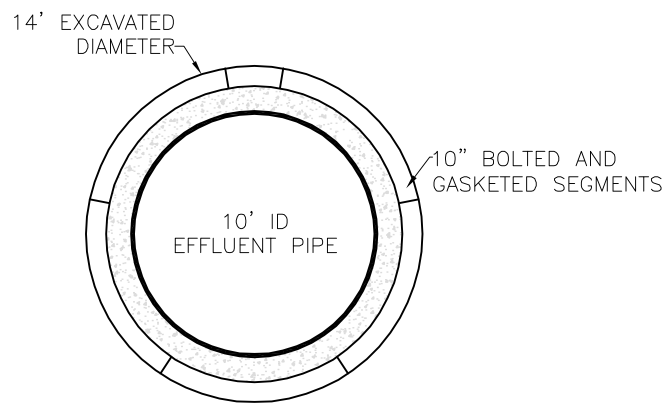


File Name: 228_Inf.dwg

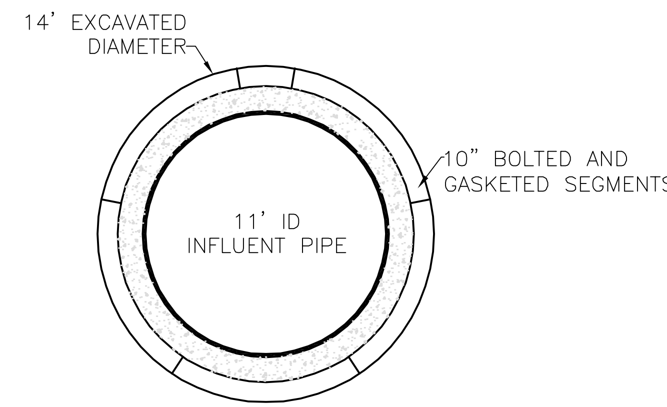
Figure 17

ROUTE 9 - 228TH ALTERNATIVE INFLUENT TUNNEL PROFILE

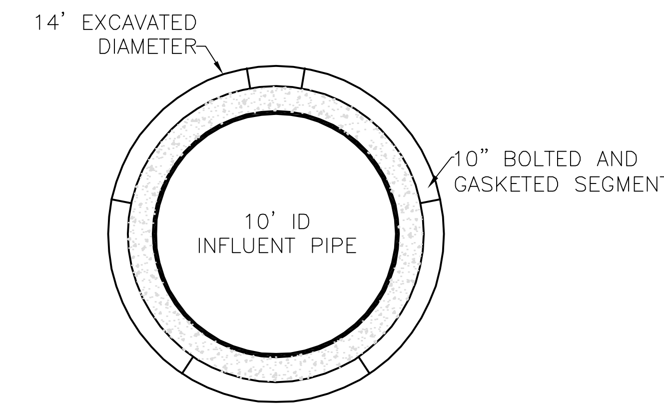
BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



ROUTE 9 SITE TO PORTAL 39
PORTAL 39 TO PORTAL 33
PORTAL 33 TO PORTAL 26
PORTAL 26 TO PORTAL 19



PORTAL 44 TO PORTAL 41
PORTAL 41 TO ROUTE 9 SITE



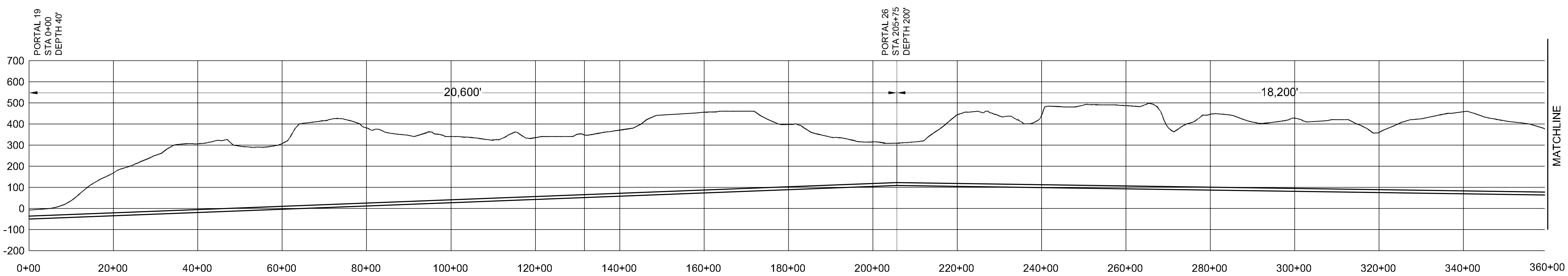
PORTAL 11 TO PORTAL 44

File Name: 228_Tunnel_sec.dwg

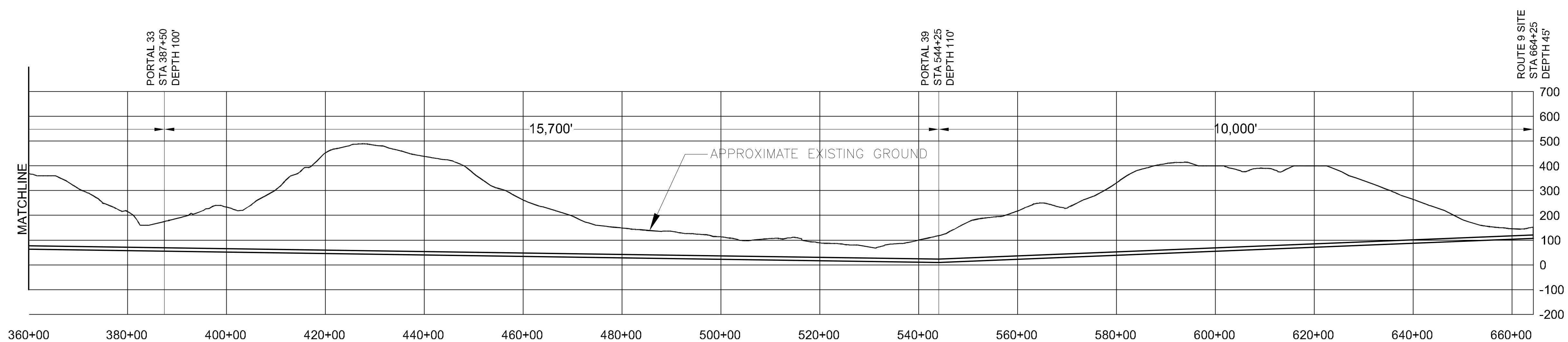
Figure 18

ROUTE 9 - 228TH ALTERNATIVE TUNNEL CROSS SECTIONS

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



PROFILE



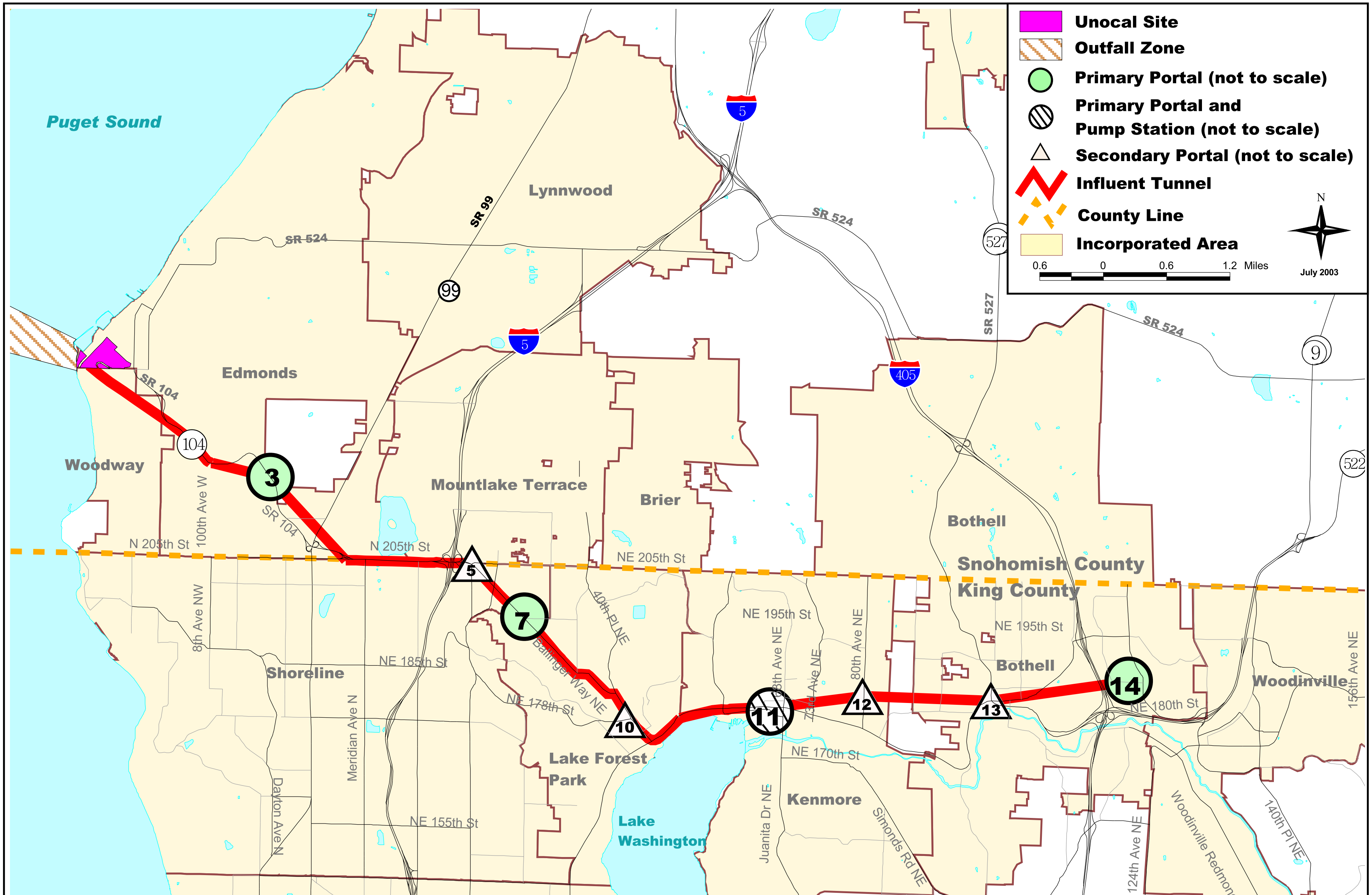
PROFILE

File Name: 228_Eff.dwg

Figure 19

ROUTE 9 - 228TH ALTERNATIVE EFFLUENT TUNNEL PROFILE

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



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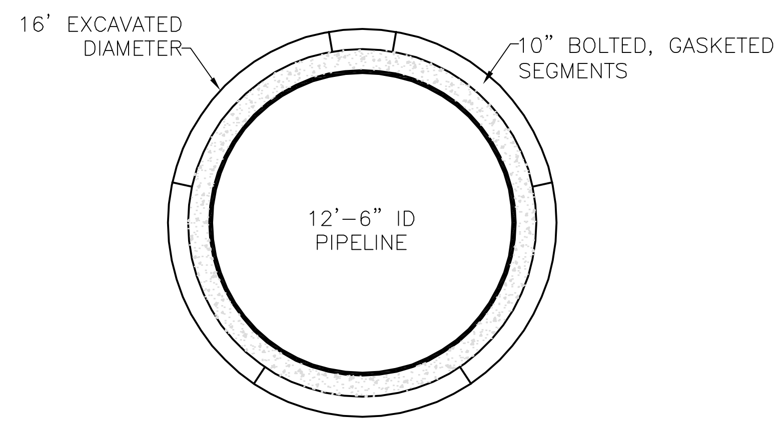
Data Source: King County
File Name: dnrp1:\\wtd\projects\bw_feis\projects\feis_regional_wtsystem.apr

Prepared by: King County WTD GIS

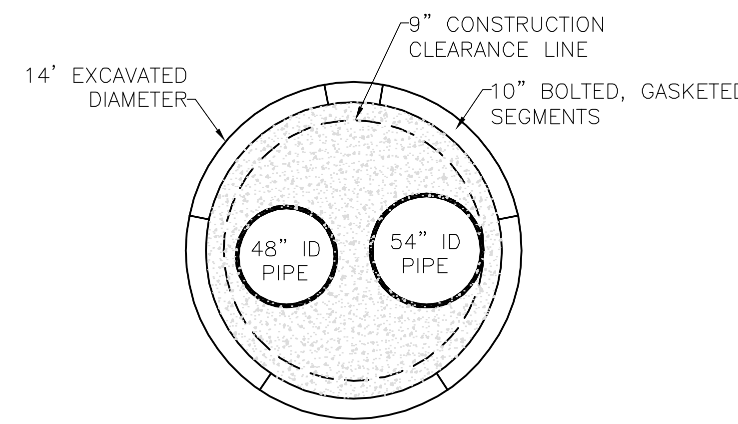
Figure 20

Unocal Corridor

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



PORTAL 14 TO PORTAL 11
PORTAL 7 TO UNOCAL SITE



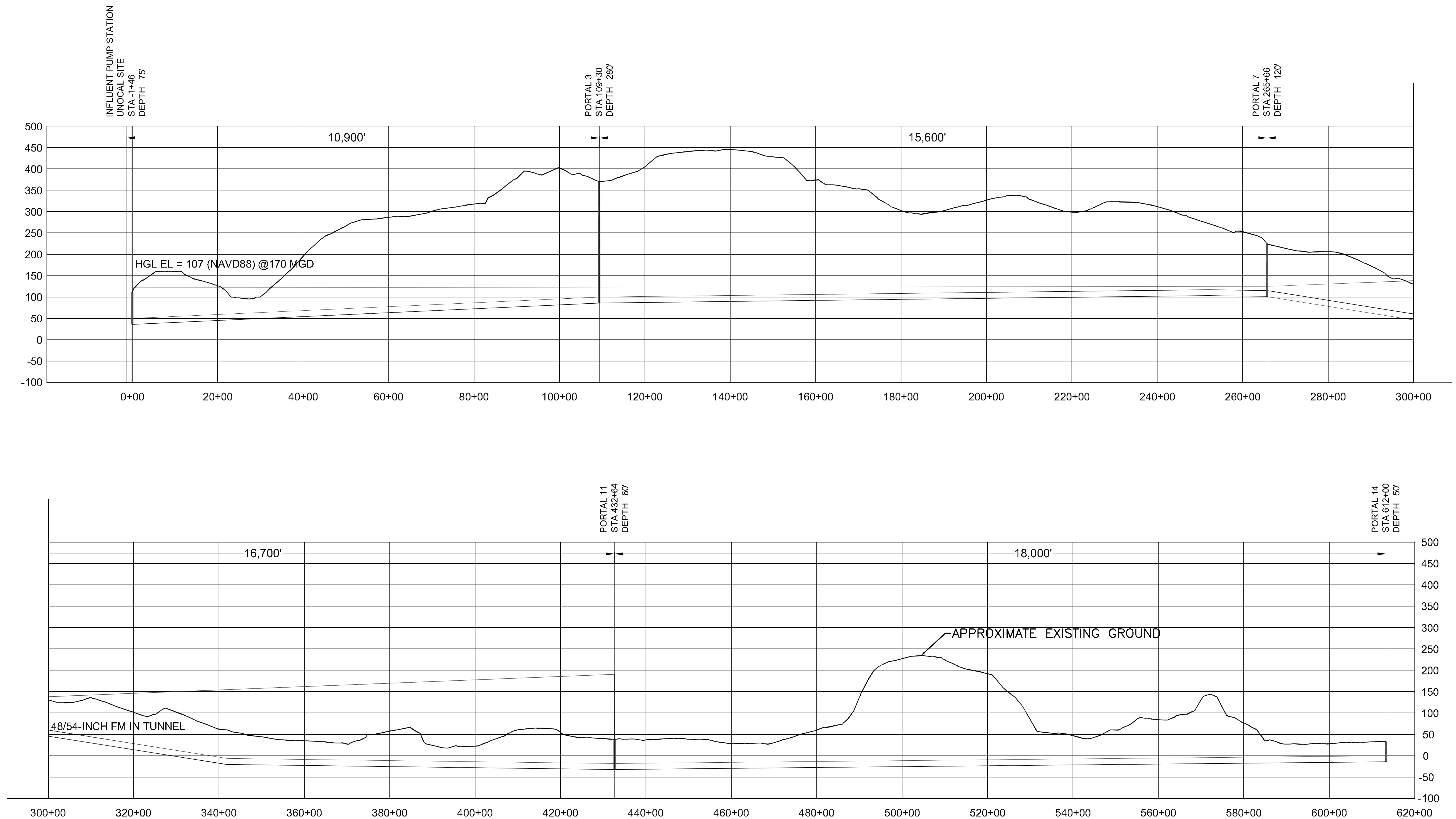
PORTAL 11 TO PORTAL 7

File Name: Unocal_Tunnel_sec.dwg

Figure 21

UNOCAL ALTERNATIVE TUNNEL CROSS SECTIONS

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

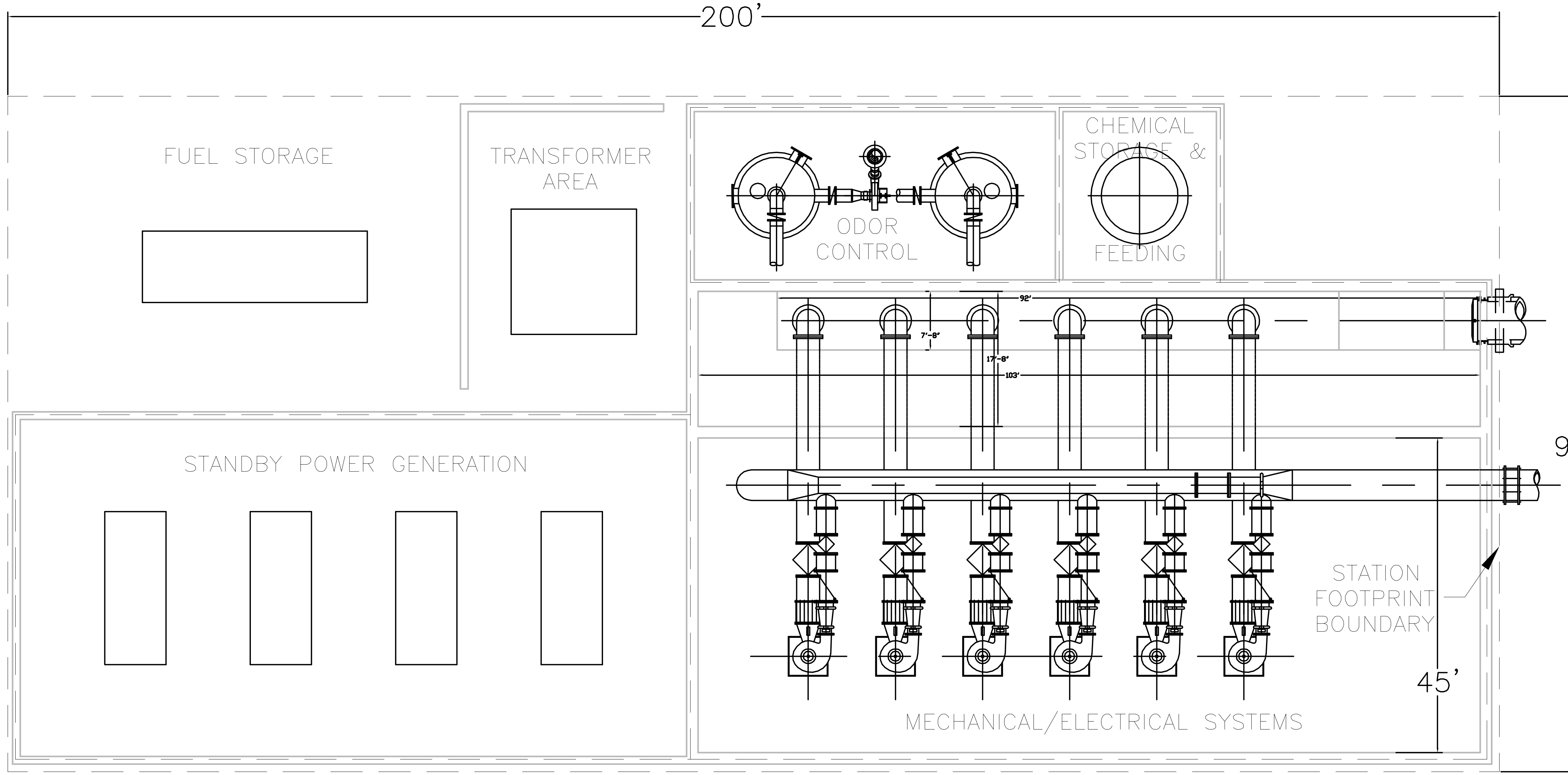


File Name: Unocal_Inf.dwg

Figure 22

UNOCAL ALTERNATIVE INFLUENT TUNNEL PROFILE

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



File Name: Inf_PS_footprint.dwg

Figure 23

UNOCAL ALTERNATIVE - INFLUENT PUMP STATION FOOTPRINT

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

Attachment A

Conveyance System Project Description Summary

Attachment A. Conveyance System Project Description Summary (IPS at Route 9 Site)

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
General Site Information			
Location	Influent – The route of the influent conveyance alignment generally crosses SR-522 between Portal 11 and 68th Avenue NE. At 68th Avenue NE, the alignment continues north to 195th Street and turns east to Portal 44 along NE 195th Street through the North Creek Business Park (Portal 41) to SR-522 and then north along SR-522 to the Route 9 site. Effluent – The effluent conveyance for the 195th Street Conveyance System would be combined in the same tunnel with the influent from the Route 9 site south along SR-522 and west along NE 195th Street to Portal 41 near the intersection of NE 195th Street and 120th Avenue NE. The tunnel would follow NE 195th Street to Portal 44 at 80th Avenue. At this point, the effluent conveyance would diverge from the influent conveyance and would continue west along NE 195th Street in public and private rights-of-way until reaching Ballinger Way NE (SR-104). The corridor then would turn northwest along Ballinger Way NE until intersecting with Portal 5 at NE 205th Street (King County designation)/244th Street SW (Snohomish County designation) at the King/Snohomish County boundary. From this location, the corridor would run west along NE 205th Street until reaching Puget Sound at Point Wells (Portal 19), where it would connect to the Zone 7S outfall.	Influent – The route of the influent conveyance alignment generally crosses SR-522 between Portal 11 and 68th Avenue NE. At 68th Avenue NE, the alignment continues north to 195th Street and turns east to Portal 44 along NE 195th Street through the North Creek Business Park (Portal 41) to SR-522 and then north along SR-522 to the Route 9 site. Effluent – The effluent portion of the 228th Street Conveyance System would follow 228th Street SE/SW in public and private rights-of-way from the Route 9 site to a point near the intersection of 228th Street SW and 95th Place West. The corridor then would turn south and generally would follow 100th Avenue West until intersecting with NW 205th Street. At NW 205th Street, the corridor would head west to connect to the Zone 7S outfall at Point Wells.	Influent – The Unocal Conveyance System would begin in the vicinity of the existing North Creek Pump Station at Portal 14 immediately northeast of the interchange of SR-522 and I-405, and would generally follow a straight cross-country path (under private right-of-way) to the existing Kenmore Pump Station (Portal 11). From Portal 11, the corridor would generally follow SR-522 (Bothell Way NE), and then turns northwest along SR-104 (Ballinger Way NE) through Portal 7. The corridor would follow SR-104(Ballinger Way NE) and after crossing I-5 near NE 205th Street, it continues west along NE 205th Street towards SR-104 (Edmonds Way). Afterward it would follow SR-104 (Edmonds Way) through Portal 3 to the Unocal site.
Affected jurisdictions	Cities of Woodinville, Bothell, Kenmore, Lake Forest Park, Shoreline, Town of Woodway, and Snohomish County	Cities of Woodinville, Bothell, Brier, Mountlake Terrace, Edmonds, Shoreline, Kenmore, Town of Woodway, and Snohomish County	Cities of Edmonds, Mountlake Terrace, Shoreline, Lake Forest Park, Kenmore, and Bothell, Town of Woodway, unincorporated King and Snohomish Counties

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Conveyance lengths and diameters (Based on peak flow of 170 mgd)	**Total Tunnel Alignment Length and Local Connection Pipeline Length– 15.9 miles (gravity and pressure pipelines and force mains)** **Influent Tunnel Alignment Total – 3.3 miles (8.1 miles including the 4.8 miles of combined tunnel section**) Influent tunnel from portal siting area 11 to portal siting area 44 1.5 miles of 14-ft diameter tunnel (10-ft inner diameter influent pipeline) **Local Influent Connections Total – 1.8 miles:** North Creek Pump Station to portal siting area 41 0.8 miles of 72-inch diameter influent microtunnel Kenmore Pump Station to portal siting area 11 100 to 1,500 feet of 72-inch diameter influent (depends on location of the portal site) Kenmore Local connection to Portal 11 0.5 mile of 21-inch diameter influent (open-cut or microtunnel) Swamp Creek connection to Portal 44 0.5 mile of 36-inch diameter influent (open-cut or microtunnel) **Combined Tunnel Alignment Total – 4.8 miles (includes both influent and effluent pipelines)** Combined influent and effluent tunnel from portal siting area 44 to portal siting area 41 2.4 miles of 24-ft diameter tunnel (11-ft inner diameter influent pipeline and twin 6-ft inner diameter effluent pipelines) Combined influent and effluent tunnel from portal siting area 41 to Route 9 plant site 2.4 miles of 24-ft diameter tunnel (twin 8-ft inner diameter influent pipelines and twin 6-ft-inner-diameter effluent pipelines) **Effluent Tunnel Alignment Total – 7.8 miles (12.6 miles including the 4.8 miles of combined tunnel section)** Effluent tunnel from portal siting area 44 to portal siting area 5 4.1 miles of 14-ft-diameter tunnel (10-ft inner diameter effluent pipeline) Effluent tunnel from portal siting area 5 to portal siting area 19 3.7 miles of 14-ft-diameter tunnel (10-ft inner diameter effluent pipeline)	**Total Conveyance Length - 20.3 miles (gravity and pressure pipelines)** **Influent Total – 8.1 miles** Influent tunnel from portal siting area 11 to portal siting area 44 1.5 miles of 14-ft diameter tunnel (10-ft inner diameter pipeline) Influent tunnel from portal siting area 44 to Route 9 plant site 4.8 miles of 14-ft diameter tunnel (11-ft inner diameter pipeline) **Local Influent Connections Total – 1.8 miles:** North Creek Pump Station to portal siting area 41 0.8 mile of 72-inch diameter (microtunnel) Kenmore Pump Station to portal siting area 11 100 to 1,500 ft (depends on location of the portal site) of 72-inch diameter influent (open-cut or microtunnel) Kenmore Local connection to Portal 11 0.5 mile of 21-inch diameter influent (open-cut or microtunnel) Swamp Creek connection to Portal 44 0.5 mile of 36-inch diameter influent (open-cut or microtunnel) **Effluent Total - 12.2 miles** From Route 9 site to portal siting area 39 1.9 miles of 14-ft diameter tunnel (10-ft inner diameter effluent pipeline) From portal siting area 39 to portal siting area 26 6.4 miles of 14-ft diameter tunnel (10-ft inner diameter effluent pipeline) From portal siting area 26 to portal siting area 19 3.9 miles of 14-ft diameter tunnel (10-ft inner diameter effluent pipeline)	**Total Conveyance Length – 11.6 miles (gravity pipelines and force mains)** From portal siting area 14 to portal siting area 11 3.4 miles of 16-ft diameter tunnel (12.5-ft inner diameter pipeline) From portal siting area 11 to portal siting area 7 3.2 miles of 14-ft diameter tunnel (48- and 54-inch inner diameter force mains) From portal siting area 7 to portal siting area 3 2.9 miles of 16-ft diameter tunnel (12.5-ft inner diameter pipeline) From portal siting area 3 to Unocal site 2.1 miles of 16-ft diameter tunnel (12.5-ft inner diameter pipeline) **Local Connections:** Kenmore Pump Station to portal siting area 11 100 to 1,500 ft of 72-inch diameter influent (depends on location of the portal site) North Creek Pump Station to portal siting area 14 100 to 1,500 feet of 60-inch diameter influent (depends on location of the portal site) Kenmore Local connection to Portal 11 0.5 mile of 21-inch diameter influent (open-cut or microtunnel)

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Pipeline material	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In combined tunnel sections or where additional lining is required due to internal or external pressure, a “second-pass” lining of steel pipe, fiberglass pipe, or cast-in-place concrete, which may include a membrane, would be used. **Microtunnel:** Reinforced concrete pipe or fiberglass pipe. **Open-cut connections:** Welded steel pipe, fiberglass pipe, or reinforced concrete pipe.	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In combined tunnel sections or where additional lining is required due to internal or external pressure, a “second-pass” lining of steel pipe, fiberglass pipe, or cast-in-place concrete, which may include a membrane, would be used. **Microtunnel:** Reinforced concrete pipe or fiberglass pipe. **Open-cut connections:** Welded steel pipe, fiberglass pipe, or reinforced concrete pipe.	**Tunnel:** The tunnel would always be lined with bolted and gasketed pre-cast concrete segments. In combined tunnel sections or where additional lining is required due to internal or external pressure, a “second-pass” lining of steel pipe, fiberglass pipe, or cast-in-place concrete, which may include a membrane, would be used. **Microtunnel:** Reinforced concrete pipe or fiberglass pipe. **Open-cut connections:** Welded steel pipe, fiberglass pipe, or reinforced concrete pipe.
Flow Management	The influent tunnel for both the Route 9 and Unocal systems would receive flows from the following locations: **Kenmore Area (Swamp Creek Trunk, Bothell-Woodinville Interceptor and Juanita Interceptor).** Under the proposed Brightwater Flow Management Plan, the Sammamish Slough Drainage System flows would be diverted at the North Creek Diversion Structure and the Northshore Drainage System flows would continue to flow in the Kenmore-Bothell Interceptor. The Northshore flows in the Kenmore-Bothell Interceptor and Swamp Creek Trunk flows would be conveyed to the Brightwater Wastewater Treatment Plant. Peak flows may still be diverted to West Point. **North Creek Area (Bothell-Woodinville Sewer Interceptor, North Creek Sewer Interceptor).** Under the proposed Brightwater Flow Management Plan, flows from the Woodinville/Bothell Interceptor and North Creek Trunk would be conveyed to the Brightwater Wastewater Treatment Plant. Peak flows may still be diverted either to West Point via the Kenmore-Bothell Interceptor or to the South Plant via the North Creek Pump Station.		
Safety Relief Point	During extreme or prolonged rain or snowfall conditions and/or during multiple equipment failure scenarios, untreated wastewater could overflow from the system into surface systems. The purpose of the safety relief point is to prevent sanitary sewer overflows into homes and private property and to provide a known location where an overflow can be monitored. The location of the proposed Safety Relief Structure would be east of 68th Avenue NE and north of the Sammamish River. The Safety Relief Structure would be constructed adjacent to the existing 78-inch diameter Kenmore Interceptor. From this structure, there would be two 72-inch diameter overflow pipes approximately 400-feet-long that would extend to the shoreline of the Sammamish River. The overflow pipes would connect to two Tideflex valves. These valves hold back the water from the Sammamish River. The pipelines would be cut at an angle to avoid obstructing the river and the crown of the discharge pipes would be a minimum of two feet below the lowest low water elevation in the Sammamish River for aesthetic reasons. Pipe material would be reinforced concrete; fiberglass reinforced plastic, ductile iron, or high-density polyethylene. Installation will involve cut-and-cover construction into the soft peat/alluvial sand.		
Tunnel range of depths	40 to 450 feet (Maximum tunnel depths are greater than portal depths because the tunnel passes below hills and the portals were located at low points to minimize portal construction depth.)	40 to 450 feet	50 to 350 feet
Primary portal depths and diameters (Diameters may vary based on depth and configuration of permanent facilities)	Portal 11 – 45 feet deep and 50-foot diameter or square excavation 40 foot by 100 foot. Portal 44 – 80 feet deep and 50-foot diameter. Portal 41 – 90 feet deep and 50-foot diameter. Portal 5 – 180 feet deep and 30-foot diameter. Portal 19 – 40 feet deep and 50-foot diameter or square excavation 40 foot by 100 foot.	Portal 11 – 45 feet deep and 50-foot diameter or square excavation 40 foot by 100 foot. Portal 44 – 80 feet deep and 50-foot diameter. Portal 41 – 90 feet deep and 50-foot diameter. Portal 39 – 110 feet deep and 50-foot diameter. Portal 33 – 100 feet deep and 50-foot diameter. Portal 26 – 200 feet deep and 30-foot diameter. Portal 19 – 40 feet deep and 50-foot diameter or square excavation 40 foot by 100 foot.	Portal 14 – 50 feet deep and 30-foot diameter. Portal 11 – 60 feet deep and 50-foot diameter. Portal 7 – 120 feet deep and 50-foot diameter. Portal 3 – 280 feet deep and 30-foot diameter.

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Primary portal earthwork volumes	Total: 31,000 yd^3 Portal 11 – 4,000 yd^3 Portal 44 – 8,000 yd^3 Portal 41 – 9,000 yd^3 Portal 5 – 6,000 yd^3 Portal 19 – 4,000 yd^3	Total: 53,000 yd^3 Portal 11 – 4,000 yd^3 Portal 44 – 9,000 yd^3 Portal 41 – 8,000 yd^3 Portal 39 – 11,000 yd^3 Portal 33 – 10,000 yd^3 Portal 26 – 7,000 yd^3 Portal 19 – 4,000 yd^3	Total: 29,000 yd^3 Portal 14 – 2,000 yd^3 Portal 11 – 6,000 yd^3 Portal 7 – 11,000 yd^3 Portal 3 – 10,000 yd^3
Tunnel earthwork volumes	Overall total: 874,000 yd^3 Reach 11-44 – 52,000 yd^3 Reach 44-41 – 277,000 yd^3 Reach 41-TP – 277,000 yd^3 Reach 44-5 – 161,000 yd^3 Reach 5-19 – 107,000 yd^3	Overall total: 696,000 yd^3 Reach 11-44 – 70,000 yd^3 Reach 44-41 – 96,000 yd^3 Reach 41-TP – 94,000 yd^3 Reach TP-39 – 75,000 yd^3 Reach 39-33 – 116,000 yd^3 Reach 33-26 – 135,000 yd^3 Reach 26-19 – 112,000 yd^3	Overall total: 554,000 yd^3 Reach 14-11 – 174,000 yd^3 Reach 11-7 – 125,000 yd^3 Reach 7-3 – 148,000 yd^3 Reach 3-TP – 107,000 yd^3
Location of portals	Primary Portal 11 – NE 175th Street and 68th Avenue NE Portal 44 – NE 195th Street and 80th Avenue NE Portal 41 – NE 195th Street and 120th Avenue NE Portal 5 – NE 205th Street and Ballinger Way NE (SR-104) Portal 19 – NW 205th Street and Richmond Beach Drive NW Secondary Portal 45 – NE 195th Street and 55th Avenue NE Portal 7 – Ballinger Way NE (SR-104) and 25th Avenue NE Portal 27 – NE 205th Street and 1st Avenue NE Portal 23 – NW 205th Street and Firdale Avenue	Primary Portal 11 – NE 175th Street and 68th Avenue NE Portal 44 – NE 195th Street and 80th Avenue NE Portal 41 – NE 195th Street and 120th Avenue NE Portal 39 – 228th Street SE and 31st Avenue SE Portal 33 – 228th Street SW and Locust Way Portal 26 – 228th Street SW and Lakeview Drive Portal 19 – NW 205th Street and Richmond Beach Drive NW Secondary Portal 37 – 228th Street SE and 9th Avenue SE Portal 30 – 228th Street SW and 35th Avenue W Portal 24 – 228th Street SW and 95th Pl W Portal 22 – NW 205th Street and 8th Avenue NW	Primary Portal 14 – North Creek Pkwy and 120th Avenue NE (This portal siting area is partly on the site of the existing North Creek Pump Station and Storage Facility. The portal would be located outside the pump station property). Portal 11 – NE 175th Street and 68th Avenue NE Portal 7 – Ballinger Way NE and 25th Avenue NE Portal 3 – SR 104 and 232nd Street SW Secondary Portal 13 – Bothell Way NE and Woodinville Drive Portal 12 – NE 183rd Street and 80th Avenue NE Portal 10 – NE 178th Street and 44th Avenue NE Portal 5 – NE 205th Street and Ballinger Way NE (SR-104)

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Construction purposes of primary portals	Portal 11 – TBM launch, spoils receiving, local connection to Swamp Creek Trunk, Woodinville-Bothell Interceptor and Juanita Trunk Portal 44 – TBM launch, TBM retrieval, spoils receiving, local connection to Swamp Creek Trunk Portal 41 – TBM launch, spoils receiving, local connection to Woodinville-Bothell Sewer Interceptor, North Creek Sewer Interceptor Portal 5 – TBM retrieval, may be used to provide lining supplies to the tunnel following removal of the TBM Portal 19 – TBM launch, spoils receiving	Portal 11 – TBM launch, spoils receiving, local connection to Swamp Creek Trunk, Woodinville-Bothell Interceptor and Juanita Trunk Portal 44 – TBM launch, TBM retrieval, spoils receiving Portal 41 – TBM launch, spoils receiving, local connection to Woodinville-Bothell Sewer Interceptor, North Creek Sewer Interceptor Portal 39 – TBM launch, TBM retrieval, spoils receiving Portal 33 – TBM launch, TBM retrieval, spoils receiving Portal 26 – TBM retrieval, may be used to provide lining supplies to the tunnel following removal of the TBM Portal 19 – TBM launch, spoils receiving	Portal 14 – TBM retrieval, local connection Portal 11 – TBM launch, spoils receiving, local connection Portal 7 – TBM launch, TBM retrieval, spoils receiving Portal 3 – TBM retrieval
Possible primary portal construction methods	Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert. Portal 44 – Concrete slurry walls with a jet-grout invert slab to provide groundwater cut-off and invert stability; localized sumps will be used to de-pressurize the invert as excavation proceeds. Portal 41 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert; alternatively jet grouting could be used to control invert seepage and provide a stable invert. Portal 5 – Concrete caisson construction or concrete slurry walls installed to depth of approximately 75 ft, excavation in the wet or dry to this depth, followed by sequential excavation and concrete lining to full depth. Portal 19 – Interlocking steel-sheet pile walls, with a jet grout invert plug to control seepage and provide for a stable invert. Local sump pump may also be required to de-pressurize invert.	Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert. Portal 44 – Concrete slurry walls with a jet-grout invert slab to provide groundwater cut-off and invert stability; localized sumps will be used to de-pressurize the invert as excavation proceeds. Portal 41 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert. Portal 39 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert. Portal 33 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert. Portal 26 – Frozen earth walls (ground freezing) to 290 ft. depth, local sump pump to control seepage through invert of excavation. Portal 19 – Interlocking steel-sheet pile walls, with a jet grout invert plug to control seepage and provide for a stable invert. Local sump pump may also be required to de-pressurize invert.	Portal 14 - Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert. Portal 11 – Interlocking steel-sheet pile walls, with local sump pump to de-pressurize invert. Portal 7 – Concrete slurry walls installed into impermeable soils below invert with local sump pump to de-pressurize the invert. Portal 3 – Frozen earth walls (ground freezing) to 290 ft. depth, local sump pump to control seepage through invert of excavation.

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Primary portal dewatering rates	Portal 11 – Range from 20 to 80 gpm for 0.5 year of portal construction; up to 80 gpm for 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time. Up to 50 gpm for 1 year of tunnel lining. Portal 44 – Range from 1 to 10 gpm for 0.5 year of portal construction; up to 140 gpm for 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 110 gpm for 1 year of tunnel lining. Portal 41 - Range from 20 to 100 gpm depending on use of jet grout for 0.5 year of portal construction; up to 100 gpm for 1 year of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 70 gpm for 1.5 years of tunnel lining. Portal 5 – 1 to 10 gpm for 1 year of portal construction activity. Portal 19 –Range from 1 to 10 gpm for 0.5 year of portal construction; up to 130 gpm for 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 100 gpm for 1 year of tunnel lining.	Portal 11 – Range from 20 to 80 gpm for 0.5 year of portal construction; up to 80 gpm for the 1 year of tunnel excavation, and up to 250 gpm for a 2-week period during this time; up to 50 gpm for 0.5 year of tunnel lining . Portal 44 – Range from 1 to 10 gpm for 0.5 year of portal construction; up to 140 gpm for the 2 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 110 gpm for the 1 year of tunnel lining Portal 41 – Range from 20 to 100 gpm depending on use of jet grout for 0.5 year of portal construction; up to 100 gpm for the 1 year of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 70 gpm for the 1.5 years of tunnel lining . Portal 39 – Range from 1 to 20 gpm for 0.5 year of portal construction; up to 110 gpm for the 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 80 gpm for the 1 year of tunnel lining. Portal 33 – Range from 1 to 20 gpm for 0.5 year of portal construction; up to 130 gpm for the 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 100 gpm for the 1 year of tunnel lining. Portal 26 – Range from 1 to 10 gpm for the 1 year of portal construction activity. Portal 19 – Range from 1 to 10 gpm for 0.5 year of portal construction; up to 140 gpm for the 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 110 gpm for the 1 year of tunnel lining.	Portal 14 – Range from 20 to 80 gpm for the 1 year of portal construction activity. Portal 11 – Range from 0 to 20 gpm for 0.5 year of portal construction; up to 120 gpm for the 1.5 years of tunnel excavation, and up to 250 gpm for four 2-week periods during this time; up to 90 gpm for the 1 year of tunnel lining. Portal 7 – Range from 1 to 10 gpm for 0.5 year of portal construction, up to 110 gpm for the 1.5 years of tunnel excavation, and up to 250 gpm for two 2-week periods during this time; up to 80 gpm for the 1 year of tunnel lining Portal 3 – Range from 20 to 50 gpm for the 1 year of portal construction activity.
Construction duration at primary portals	Portal 11 – 2.0-2.5 years Portal 44 – 3.5-4.0 years Portal 41 – 3.0 years Portal 5 – 1.0 year Portal 19 – 3.5-4.0 years	Portal 11 – 2.0-2.5 years Portal 44 – 3.0-3.5 years Portal 41 – 2.5-3.0 years Portal 39 – 3.0 years Portal 33 – 3.0-3.5 years Portal 26 – 1.0 year Portal 19 – 3.5 years	Portal 14 – 1.0 year Portal 11 – 3.5-4.0 years Portal 7 – 3.0 years Portal 3 – 1.0 year
Influent pump stations	No new pump stations outside of treatment plant.	No new pump stations outside of treatment plant.	One new pump station at portal siting area 11.

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Permanent Facility Characteristics			
Odor Control Facilities	Portal 11 – Two-stage odor control—either two carbon units or a combination chemical scrubber and carbon unit. Portal 41 – Two-stage odor control—a combination chemical scrubber and carbon unit. Portal 44 – Two-stage carbon odor control units. Portal 5 – Single-stage odor control - biofilter or carbon unit. Kenmore PS - Chemical Injection (reuse existing). North Creek PS – Chemical Injection (reuse existing), and add a second tank.	Portal 11 – Two-stage odor control—either two carbon units or a combination chemical scrubber and carbon unit Portal 41 – Two-stage odor control—a combination chemical scrubber and carbon unit Portal 44 – Two-stage carbon odor control units. Portal 26 – Single-stage odor control—Biofilter or carbon unit Kenmore PS - Chemical Injection (reuse existing) North Creek PS - Chemical Injection (reuse existing) add second tank.	Portal 11 – Two-stage odor control systems—either two carbon units or a combination chemical scrubber and carbon unit Portal 14 - Reuse North Creek Pump Station Odor Control System Portal 7 – Three-stage odor control – bioscrubber, chemical scrubber, and carbon unit Kenmore PS - Chemical Injection (reuse existing) North Creek PS - Chemical Injection (reuse existing) add second tank.
Dechlorination Facility	Portal 5	Portal 26	None in conveyance
Sampling Station	Portal 19	Portal 19	None in conveyance
Miscellaneous Structures	Portal 11 - Drop Structure (below ground). Portal 41 - Drop Structure (below ground). Portal 44 – Drop Structure (below ground). Portal 5 - Air Handling Facility (part of odor control facility), transition structure (below ground) Portal 19 - Transition Structure and sampling station (below ground). North Creek PS – Drop Structure (partially aboveground). Diversion Structure (below ground). Kenmore PS - Diversion Structure (below ground).	Portal 11 - Drop Structure (below ground). Portal 41 - Drop Structure (below ground). Portal 44 - Drop Structure (below ground). Portal 26 - Air Handling Facility (part of odor control facility), transition structure (below ground) Portal 19 - Transition Structure, sampling station (below ground). North Creek PS - Drop Structure (partially aboveground); Diversion Structure (below ground). Kenmore PS - Diversion Structure (below ground).	North Creek PS - Drop Structure (partially aboveground). Diversion Structure (below ground). Portal 14 - Drop Structure (below ground). Portal 11 - Drop Structure (below ground). Kenmore PS - Diversion Structure (below ground). Portal 7 - Force Main Discharge Structure (below ground).

	Route 9-195th Street System	Route 9-228th Street System	Unocal System
Primary Portal Ultimate Use	Primary portals will remain for permanent access. A minimum structure with a manhole of about 12-foot inner diameter will remain inside the portal location. In addition to access, the following portals will have permanent facilities contained within the portal location. Portal 11 - Junction Structure (below ground) and aboveground two-stage odor control approximately 1,500 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 41 - Drop Structure (below ground) and aboveground two- or three-stage odor control approximately 2,000 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 44 - Drop Structure (below ground) and aboveground two-stage odor control approximately 1,500 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 5 - Air Handling shaft below ground and aboveground single stage odor control approximately 1,000 square feet with Electrical Room approximately 400 square feet, height 15 feet. Dechlorination facility approximately 1,200 square feet, height 20 feet. Transition structure (approximately 300 square feet, below ground). Portal 19 - Transition Structure (300 square feet) and sampling station approximately 400 square feet (below ground).	Primary portals will remain for permanent access. A minimum structure with a manhole of about 12-foot inner diameter will remain inside the portal location. In addition to access, the following portals will have facilities contained within the portal location. Portal 11 - Junction Structure (below ground) and aboveground two-stage odor control approximately 1,500 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 41 - Drop Structure (below ground) and aboveground two-stage odor control approximately 2,000 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 44 - Drop Structure (below ground) and aboveground two-stage odor control approximately 1,500 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 26 - Air Handling shaft below ground and aboveground single stage odor control approximately 1,000 square feet with Electrical Room approximately 400 square feet, height 15 feet. Dechlorination facility approximately 1,200 square feet, height 20 feet. Transition structure (approximately 300 square feet, below ground). Portal 19 - Transition Structure (300 square feet) and sampling station (400 square feet) (below ground). Portal 39 – Manhole Portal 33 - Manhole	Primary portals will remain for permanent access. A minimum structure with a manhole of about 12-foot inner diameter will remain inside the portal location. In addition to access, the following portals will have facilities contained within the portal location. Portal 14 - Drop Structure (below ground) and aboveground reuse existing North Creek PS odor control system. Portal 11 - Pump Station (aboveground) approximately 18,000 square feet; Diversion Structure (below ground) and aboveground twin two-stage odor control system approximately 4,000 square feet with Electrical Building approximately 400 square feet, height 20 feet. Portal 7 - Force main discharge structure (below ground) and aboveground three-stage odor control approximately 3,000 square feet with Electrical Room approximately 400 square feet, height 20 feet. Portal 3 - Manhole

	Route 9-195th Street System			
Candidate Portal Sites	Portal	Candidate Sites	Size (Acres)	Access Roads
	Primary Portals			
	11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	SR-522 (NE Bothell Way) 68th Avenue NE/Juanita Drive NE 175th Street
	41	Site 41-A Site 41-C Site 41-D Site 41-J Site 41-X Site 41-W	6.7 16.1 4.6 3.7 5.1 3.3	I-405 NE 195th Street 120th Avenue NE North Creek Parkway Beardslee Boulevard
	44	Site 44-C Site 44-D Site 44-E	3.6 8.8 2.3	SR-522 (NE Bothell Way) 80th Avenue NE NE 195th Street
	5	Site E5-B Site E5-G Site E5-X	3.3 1.8 1.0	SR-104 (Ballinger Way NE) 15th Avenue NE SW 225th Street
	19	Site E19-A Site E19-C Site E19-E	1.9 8.5 3.4	SR-99 N 185th Street Fremont Avenue NW Richmond Beach Road NW 195th Street NW 196th Street Richmond Beach Drive
	Secondary Portals			
	7	Site E7-A Site E7-B Site E7-C	9 2.9 4.5	I-5 SR-104 (Ballinger Way NE) 25th Avenue NE
	23	Site E23-A Site E23-D Site E23-F	3.1 2.2 1.5	SR-104 (Ballinger Way NE) 244th Street SW Firdale Avenue 8th Avenue NW/100th Avenue W

	Route 9-228th Street System			
Candidate Portal Sites	Portal	Candidate Sites	Size (Acres)	Access Roads
	Primary Portals			
	11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	SR-522 (NE Bothell Way) 68th Avenue NE/Juanita Drive NE 175th Street
	41	Site 41-A Site 41-C Site 41-D Site 41-J Site 41-X Site 41-W	6.7 16.1 4.6 3.7 5.1 3.3	I-405 NE 195th Street 120th Avenue NE North Creek Parkway Beardslee Boulevard/Ross Road.
	44	Site 44-C Site 44-D Site 44-E	3.6 8.8 2.3	SR-522 (NE Bothell Way) 80th Avenue NE NE 195th Street
	39	Site E39-B Site E39-C Site E39-D	2.9 2.3 2.2	228th Street SW Bothell Everett Highway
	33	Site E33-A Site E33-C Site E33-D	2.7 3.0 3.0	SR-527 228th Street SW Locust Way
	26	Site E26-A Site E26-C Site E26-D	3.0 8.9 4.4	SR-104 SR-99 224th Street SW 73rd Avenue W 228th Street SW
	19	Site E19-A Site E19-C Site E19-E	1.9 8.5 3.4	SR-99 N 185th Street Fremont Avenue NW Richmond Beach Road NW 195th Street NW 196th Street Richmond Beach Drive
	Secondary Portals			

	Unocal System			
Candidate Portal Sites	Portal	Candidate Sites	Size (Acres)	Access Roads
	Primary Portals			
	3	Site I3-D Site I3-E Site I3-F	1.9 2.3 2.0	Edmonds Way (SR-104) 92nd Avenue W 232nd Street SW
	7	Site I7-A Site I7-B Site I7-C	9.0 2.9 4.5	I-5 SR-104 (Ballinger Way NE) 25th Avenue NE
	11	Site I11-A Site I11-B Site I11-C	2.3 4.3 4.1	68th Avenue NE/Juanita Drive NE 175th Street SR-522 (Bothell Way)
	14	Site I14-A Site I14-B Site I14-D	4.0 3.7 3.2	Inbound: NE 195th Street North Creek Parkway 120th Avenue NE Outbound: NE 180th Street 132nd Avenue NE SR-522 (Bothell Way)
	Secondary Portals			
	5	Site E5-B Site E5-G Site E5-X	3.3 1.8 1.0	SR-104 (Ballinger Way NE) 15th Avenue NE SW 225th Street
	10	Site I10-A Site I10-C Site I10-D Site I10-E	5.6 3.8 4.0 1.7	SR-522 (NE Bothell Way) 44th Avenue NE SR –104 (Ballinger Way NE) NE 178th Street Brookside Blvd NE
	12	Site I12-C Site I12-E	3.1 2.1	SR-522 (NE Bothell Way) 175th Street NE 73rd Avenue NE

	Route 9-195th Street System				Route 9-228th Street System				Unocal System			
	Portal	Candidate Sites	Size (Acres)	Access Roads	Portal	Candidate Sites	Size (Acres)	Access Roads	Portal	Candidate Sites	Size (Acres)	Access Roads
	27	Site E27-A Site E27-B Site E27-C	7.2 2.9 2.6	SR-104 (Ballinger Way NE) 1st Avenue NE 76th Avenue W 242nd Place SW	22	Site E22-A Site E22-C Site E22-D Site E22-E Site E22-F	3.1 3.3 2.2 2.4 1.5	SR-104 (Ballinger Way NE) 244th Street SW 100th Avenue W/8th Avenue NW NW 200th Street 10th Avenue NW Firdale Avenue	13	Site I13-A Site I13-B Site I13-C	2.0 3.0 2.7	Bothell Way/Woodinville Drive (SR-522)
	45	Site E45-A Site E45-C Site E45-D	1.9 3.2 3.8	SR-522 (NE Bothell Way) 61st Avenue NE 55th Avenue NE NE 190th Street / NE 193rd Street	24	Site E24-A Site E24-B Site E24-C	2.4 2.1 2.2	Edmonds Way (SR-104) 95th Pl W 228th Street SW				
					30	Site E30-A Site E30-B Site E30-C	2.5 2.0 4.9	SR-104 236th Street SW Cedar Way 35th Avenue W 228th Street SW				
					37	Site E37-A Site E37-C Site E37-D	2.7 1.7 4.5	SR-527 228th Street SW 9th Avenue SE 19th Avenue SE				

Attachment B

Odor Control Technologies

Odor Control Technologies

Odor/Corrosion Control

Numerous technologies available for odor control were previously reviewed in a pass/fail screening by the Brightwater Wastewater Treatment Plant design team and King County. This section evaluates the technologies recommended at the screening workshops as potential odor control strategies for the Brightwater Conveyance System. The odor control technologies selected are consistent with experience at King County and on other conveyance system odor control projects.

Liquid-Phase Treatment Technologies

Liquid-phase treatment technologies treat the hydrogen sulfide (H_2S) in the liquid stream of collection systems before it is released as a vapor. The preferred liquid-phase treatment technologies are described below.

Calcium Nitrate

The addition of nitrate salts to wastewater removes dissolved sulfide by forcing microorganisms to oxidize it. The nitrate also prevents sulfide generation because bacteria use the nitrate as an oxygen source rather than reducing sulfate. Calcium nitrate ($Ca(NO_3)_2$) is frequently used to add oxygen in the form of nitrate. A detention time of about 2 hours is required to effectively remove existing sulfide, so conveyance systems with short detention times would not be effectively treated by nitrate addition. The chemical reactions associated with nitrate addition produce no chemical precipitates in the wastewater stream, preventing any increase in solids-handling costs at the downstream wastewater treatment plant. A typical calcium nitrate injection system consists of the following equipment:

- Calcium nitrate
- A storage tank
- Metering pumps
- A control panel
- Valves and piping

A proprietary product consisting mainly of calcium nitrate, and sold under the trade name of Bioxide, is made by U.S. Filter/Davis Water Process. Bioxide is widely used and has proven to effectively reduce sulfide generation and control corrosion and odors in conveyance systems. It contains a minimum of 3.5 pounds of nitrate-oxygen per gallon. Nitrate is not chemically reactive with organics, so the dosage is related to the amount of sulfide/sulfate present.

Iron Salts

Metals can chemically combine with dissolved sulfide to form relatively insoluble metal sulfides, which precipitate from the wastewater. Chromium, cadmium, nickel, copper and other metals are available for reacting with sulfide, but produce pollutant metal sulfide in the sludge. Iron salts, such as ferrous chloride, ferrous sulfate, ferric chloride, and ferric sulfates, have proven effective for chemical precipitation of sulfides. The iron combines with the sulfide to form an insoluble precipitate. Iron and dissolved oxygen may work in combination to reduce dissolved sulfide levels. Iron can lower dissolved sulfide efficiently to concentrations of 1.0 to 2.0 mg/L at iron-to-sulfide weight ratios of 2:1 to 4:1. Lowering the dissolved concentration below 0.5 mg/L can require iron-to-sulfide ratios of up to 10:1.

Vendors provide iron salts in solutions of varying chemical strengths. A potential problem with adding ferrous sulfate is that additional sulfates are made available for reduction to sulfide. A side benefit of iron salt addition is that it raises the oxidation-reduction potential of the wastewater. Ferric chloride is typically more effective than ferrous chloride due to its higher oxidation potential. However, it is not readily available in the Northwest, making it less cost-effective than ferrous chloride. A typical iron-salt injection system consists of the following equipment:

- Iron salt
- A storage tank
- Metering pumps
- A control panel
- Valves and piping

Sodium Hypochlorite

Chlorine is widely used for disinfecting municipal wastewater. A chlorine option for sulfide control is direct addition of sodium hypochlorite (NaOCl). The primary advantage of liquid NaOCl (bleach) is its ease of handling. It rapidly oxidizes sulfide, so it does not require a long detention time. It is also effective in a wide range of applications and oxidizes many odorous compounds. Disadvantages are its cost and its limited shelf life. NaOCl may be considered in specific situations where a short detention time dictates a faster reaction time. A typical sodium hypochlorite system consists of the following equipment:

- Hypochlorite
- A storage tank
- Metering pumps
- A control panel
- Valves and piping

Vapor-Phase Treatment Technologies

Vapor-phase treatment does not prevent corrosion, but treats the foul air emanating from sewers by removing odor-causing compounds from a gaseous stream prior to discharge to the atmosphere. The most common sewage system odor, often compared to the smell of rotten eggs, is attributable to hydrogen sulfide. Other reduced sulfur compounds and low-molecular-weight volatile organic compounds can also be a part of an odor problem. The vapor-phase treatment technologies discussed below were selected at the screening workshop.

Chemical Scrubber

The most commonly used odor control process for municipal wastewater systems is liquid chemical scrubbing in towers containing plastic packing media. The scrubber solution cascades down over the media as the foul air flows up, and odor-causing contaminants are transferred from the air to the liquid. The media provides increased surface area for contact and reaction between the foul air and the scrubbing liquid. The scrubber solution is constantly recycled in the tower with a small percentage being wasted to the sewer system and a small amount of fresh chemicals being added to make up for wasting and evaporation. The scrubbing solution is maintained at a high pH (approximately 9 to 10) to promote the absorption of hydrogen sulfide into the solution as the sulfide ion. By connecting chemical metering pumps to pH and oxidation-reduction-potential (ORP) probes, the amount of chemical can be varied to meet fluctuations in the incoming odor concentrations. Packed-bed units are sized for face velocities of 400 to 500 feet per minute. Drainage of the sump must be provided to prevent solids accumulation. This is accomplished by using a constant supply of makeup water with continuous overflow at the sump. A typical chemical scrubber system consists of the following equipment:

- Chemical scrubber tower
- Packing media
- Intake fan/blower
- Spray water recirculation pump
- Chemical metering pumps
- Chemical storage tanks
- ORP and pH probes
- Neutralization system or caustic addition
- Control panel
- Air distribution piping network and valves.

Activated Carbon

Carbon removes pollutants by surface adhesion and absorption. Carbon’s highly porous structure supplies a large surface area per unit of volume. Granular activated carbon (GAC) is the most common of several types of media used for adsorption. GAC treatment systems typically consist of a stainless steel or fiberglass vessel containing a bed of granular activated carbon through which the foul air is discharged.

Activated carbon is not suitable for high contaminant concentrations because the bed life would be rapidly depleted, resulting in the need for frequent replacement and high operating costs. Carbon absorption is often used to treat foul air with low levels of contaminants. At hydrogen sulfide concentrations below 10 parts per million (ppm), carbon absorbers can reduce hydrogen sulfide concentrations to very low levels. Carbon units are sized for face velocities of 40 to 75 feet per minute and typically use a media depth of 3 feet. A variety of carbon vessels are available, with large units typically having dual beds in a single vessel. A typical activated carbon system consists of the following equipment:

- Carbon vessel
- Activated carbon media
- Intake fan/blower
- Control panel
- Valves and piping

Biofiltration

Biofiltration is a biological process using soil, compost or other media as substrate for microbes that remove odorous contaminants from foul air traveling through the media. The advantage of biofilters is that they can provide effective treatment for a wide variety of odor-causing compounds. Contaminant removal also takes place by adsorption onto the surface of the media, allowing additional time for biodegradation by the microbes. Sufficient residence time must be provided for microbes to accomplish effective contaminant treatment, so biofilters must use a low air velocity. For hydrogen sulfide removal, typical residence times range from 30 to 90 seconds. Longer residence times may be necessary for foul air with high hydrogen sulfide concentrations or different compounds to be treated; some compounds require several minutes of residence time for effective removal.

The key elements in biofilter design are media, air distribution, and moisture. Biofilter media is usually composed of organic materials such as wood chips, compost, soil, peat moss, or a combination of these. Improper media can compact or become too soggy and lose its porosity quickly; a properly formulated media would retain its structure over several years. Media porosity is also an important consideration to minimize head loss across the bed. To maintain reasonable head losses, bed depths are limited to 3 or 4 feet and face velocities range from 2 to 8 feet per minute. The low velocity means that biofilters require a very large footprint. Biofilter media degrades with use and eventually must be replaced. The life cycle is dependent on the media type and the contaminant concentration, but typically ranges from 2 to 5 years.

Good air distribution through the biofilter media is an essential element of biofilter design. If air distribution is uneven, treatment would be inconsistent and channels can develop, allowing air to escape untreated. Another key parameter influencing the effectiveness of biofilters is moisture content. Biofilters must operate at moisture content consistent with the requirements of microbial life, typically in the 40 to 60 percent range. Proper moisture content also prevents media from drying and cracking, which would allow the escape of untreated odors. Well-designed biofilters employ means of adding moisture to the air stream, to the media internally, or to the top surface of the media. In some cases, control equipment is installed to sense the moisture content of the biofilter and automatically increase moisture as needed. Fine mist systems can have problems with nozzle scaling. To avoid this, a coarse spray can be used, which may also allow for maintaining temperature with a water-heating device. Some systems use permeable hoses embedded in the media. Because of their large footprint, biofilters are not feasible at all critical locations in a collection system. However, they are appropriate for locations with adequate space. A typical biofilter system consists of the following equipment:

- Biofilter vessel
- Filter media
- Intake fan/blower
- Neutralization system or caustic addition
- Control panel
- Air distribution piping network and valves.

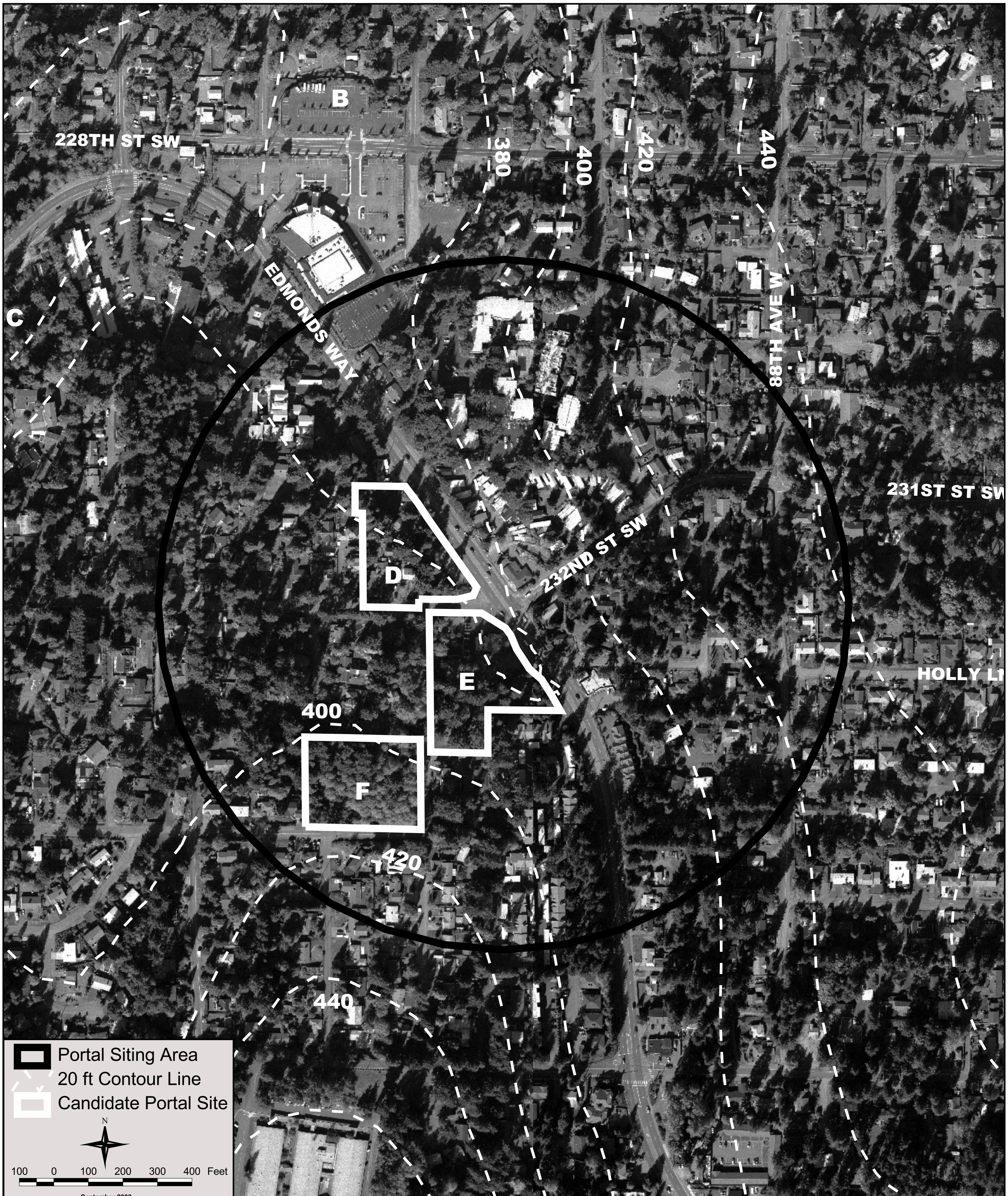
Bioscrubber

Bioscrubbers are similar to biofilters, but the microbes are suspended in water rather than attached to a fixed media surface. The scrubber is a tower like those used for chemical scrubbers, with media through which the microbe-bearing water is recirculated. Foul air passed through the media at a relatively high velocity comes into contact with the recirculating water that is also passing through the media. Contaminants in the foul air are absorbed into the water, where they are metabolized by the microbes suspended in it. Nutrients are added to the recirculating water on a continuous or periodic basis. External vessels that allow an increased quantity of water to be in the process at any given moment can be used to increase the effective residence time and removal efficiency. Bioscrubbers are subject to fouling as a result of biomass accumulation and require continuous or periodic blowdown to remove biological byproducts and excess biomass. Bioscrubbers typically have smaller footprints than biofilters. Due to the high air velocities through the media, bioscrubbers typically have a pressure drop in the range of 5 to 15 inches of water. A typical bioscrubber system consists of the following equipment:

- Bioscrubber tower
- Biological media
- Intake fan/blower
- Spray water recirculation pump
- Spray distribution system
- Neutralization system or caustic addition
- Air distribution piping network and valves

Attachment C

Candidate Portal Sites



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

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Data Source: King County

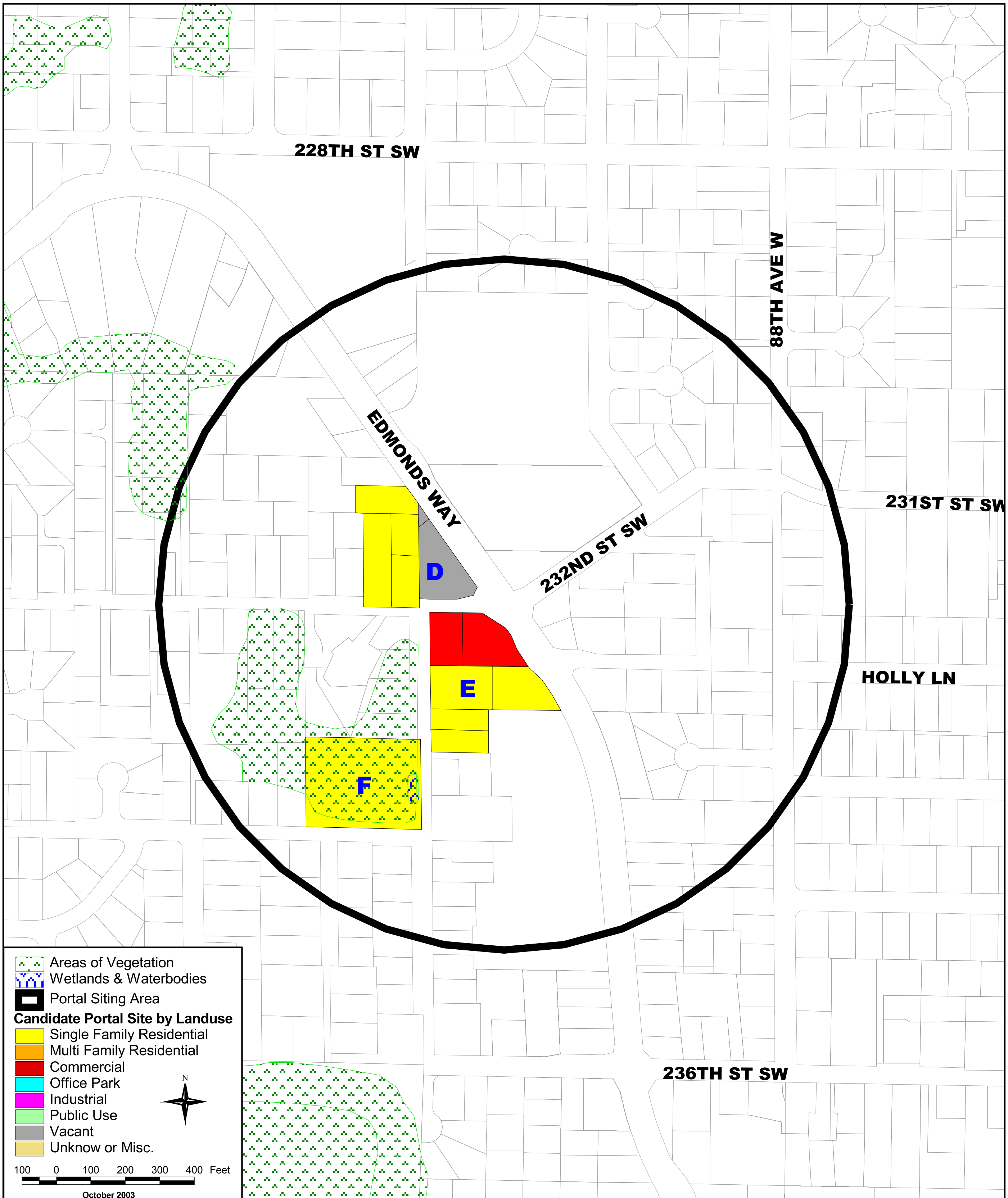
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels.apr Shari Cross

Prepared by: King County WTD GIS

Figure 1-A

Portal Siting Area 3
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



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Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross

Prepared by: King County WTD GIS

Figure 1-B

Portal Siting Area 3
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County

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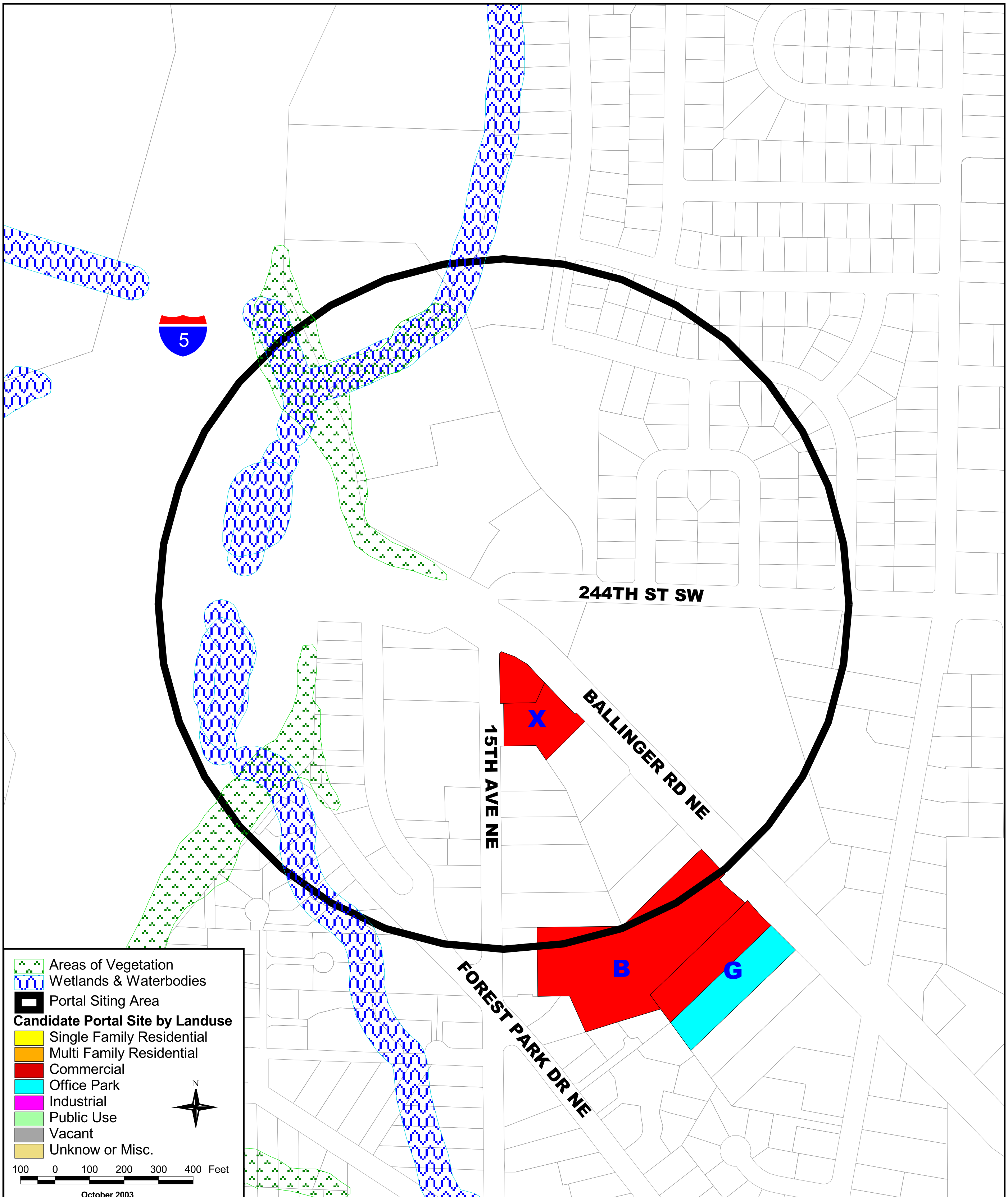
Figure 2-A

Portal Siting Area 5
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



King County
Department of
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Wastewater Treatment Division

Data Source: King County
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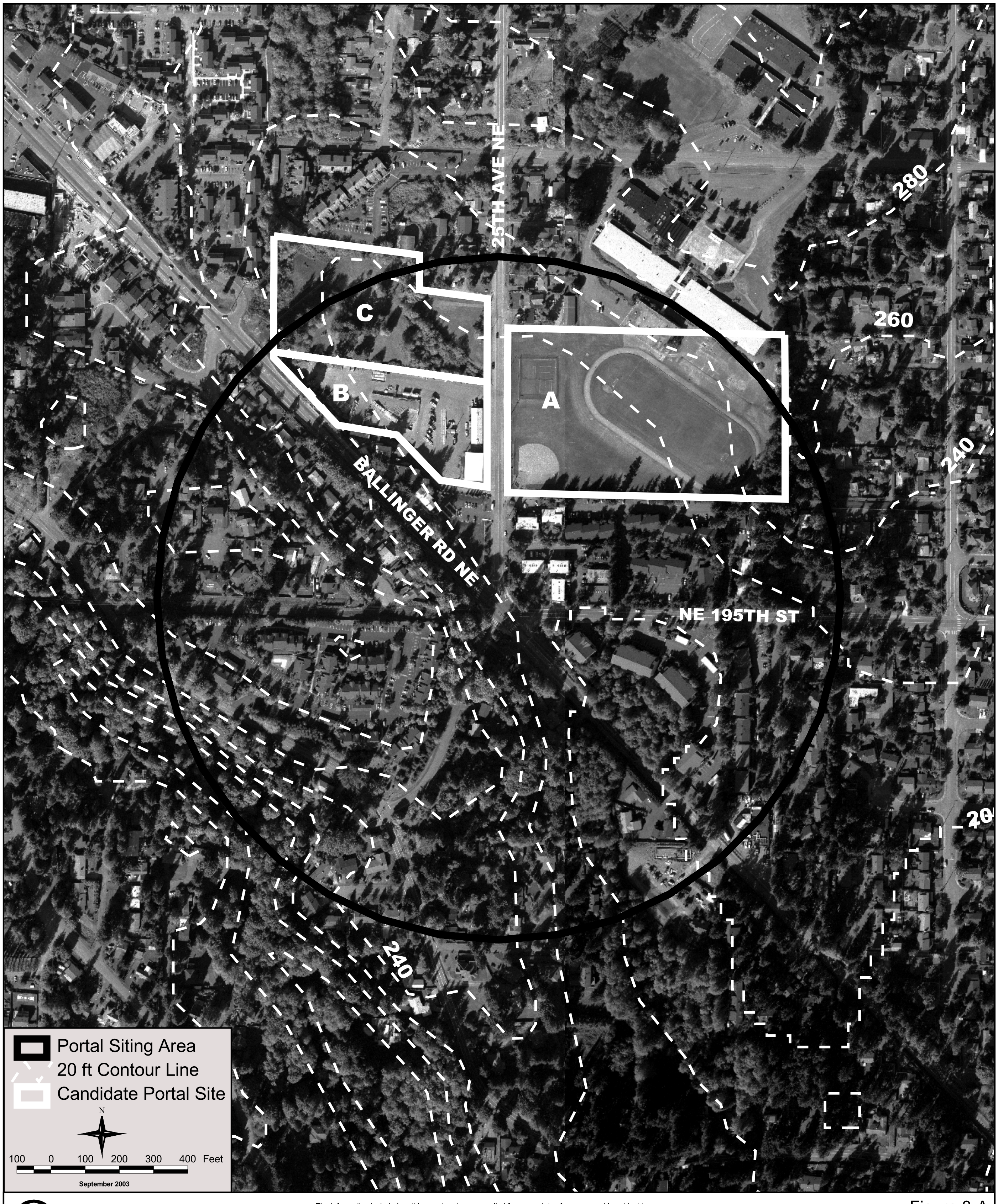
Prepared by: King County WTD GIS

Figure 2-B

Portal Siting Area 5
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



King County
Department of
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Wastewater Treatment Division

Data Source: King County

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels.apr Shari Cross

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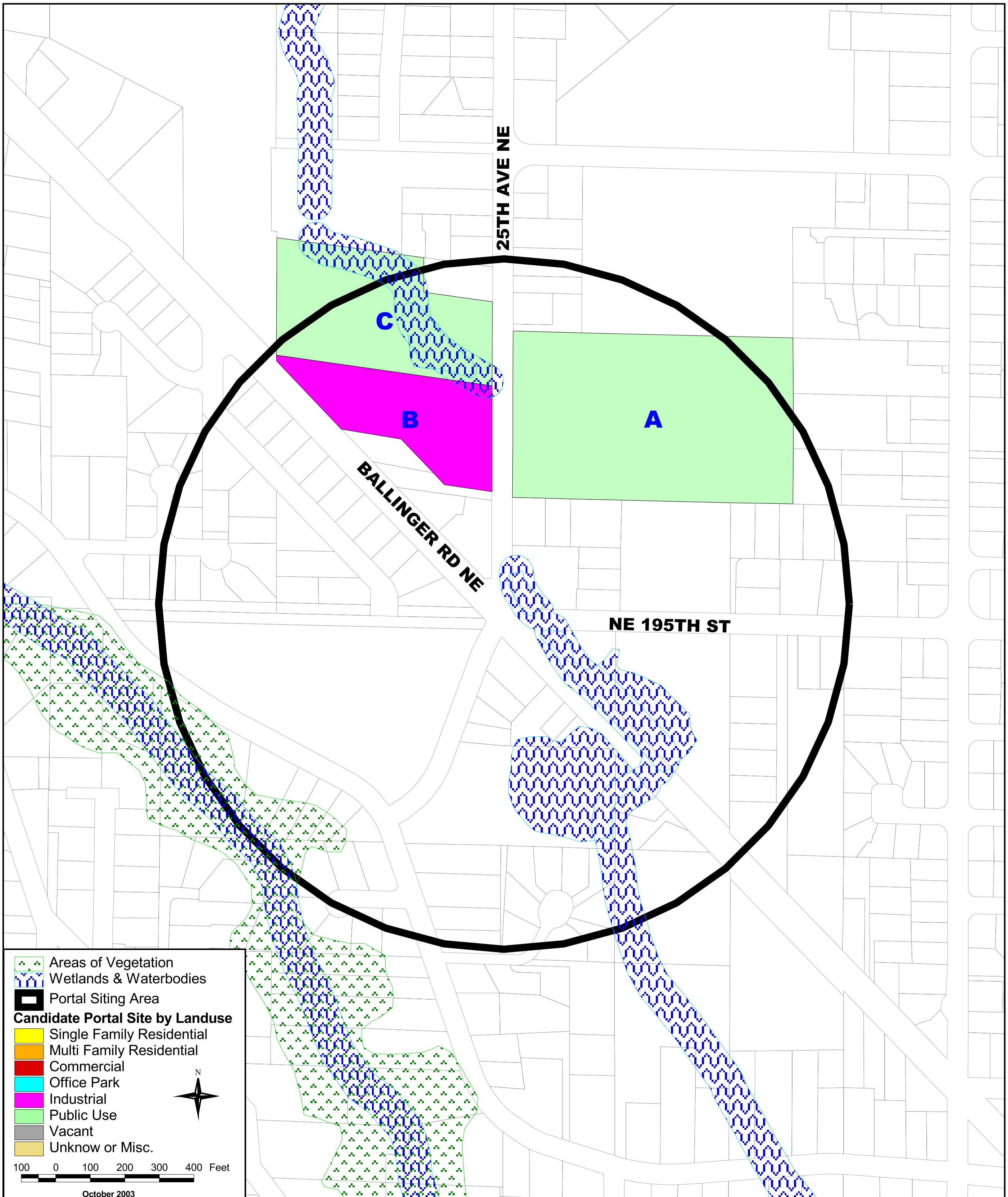
Figure 3-A

Portal Siting Area 7
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



King County
Department of
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Wastewater Treatment Division

Data Source: King County

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross

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Figure 3-B

Portal Siting Area 7
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

King County
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Data Source: King County

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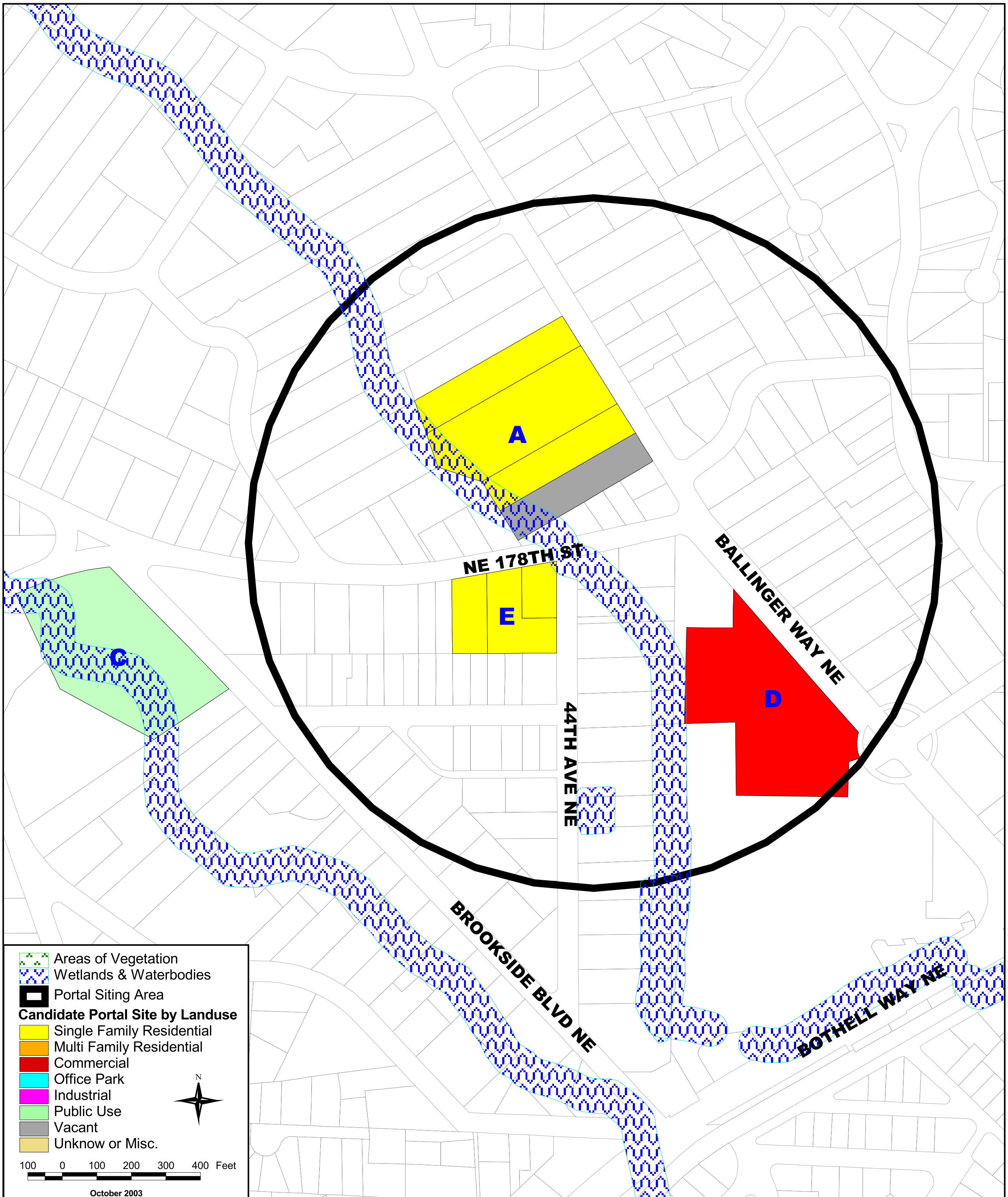
Figure 4-A

Portal Siting Area 10
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



King County
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Data Source: King County

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Figure 4-B

Portal Siting Area 10
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

King County
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Figure 5-A

Portal Siting Area 11
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

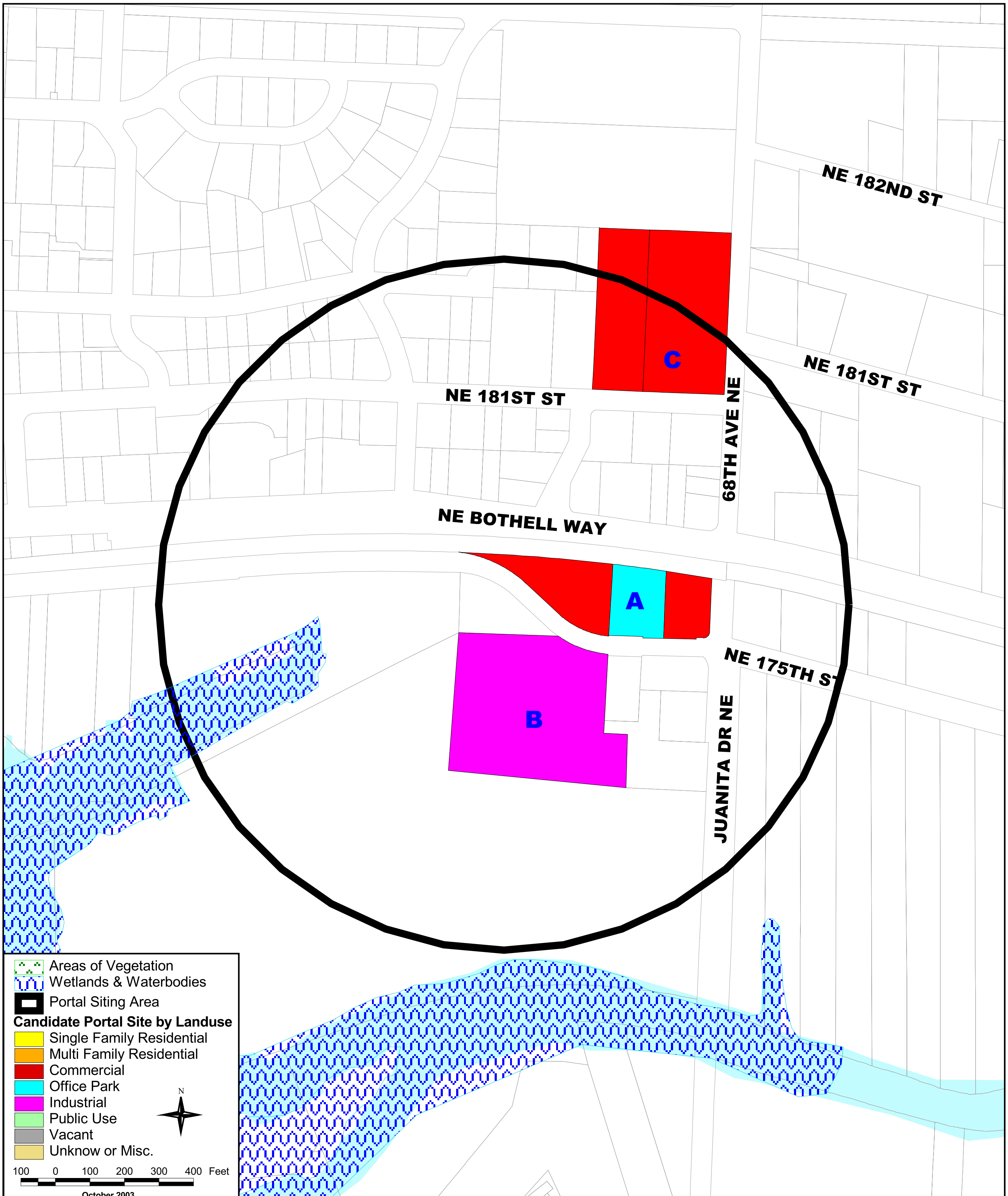

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Figure 5-B
Portal Siting Area 11
Candidate Portal Sites
BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

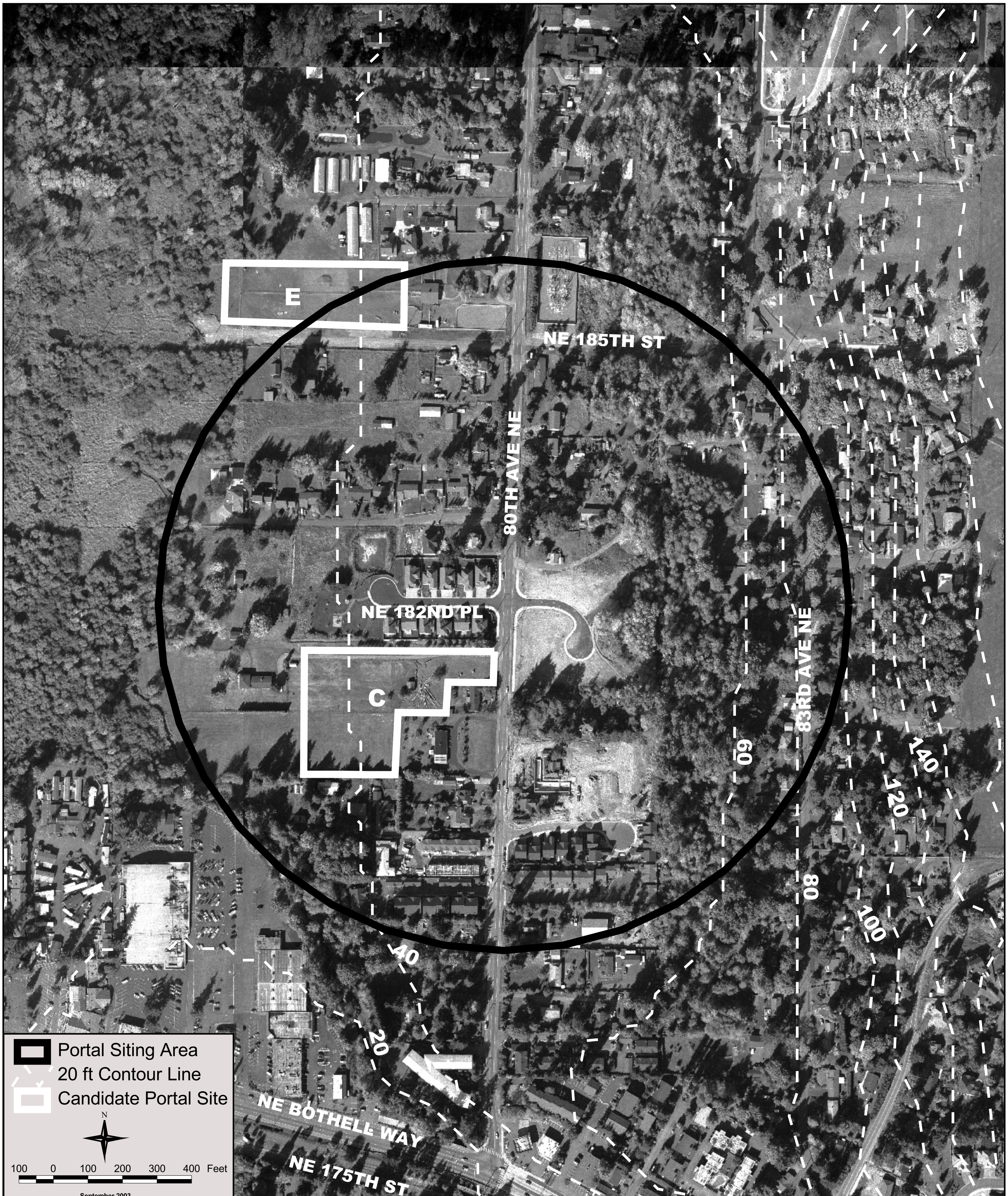

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Figure 6-A

Portal Siting Area 12
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

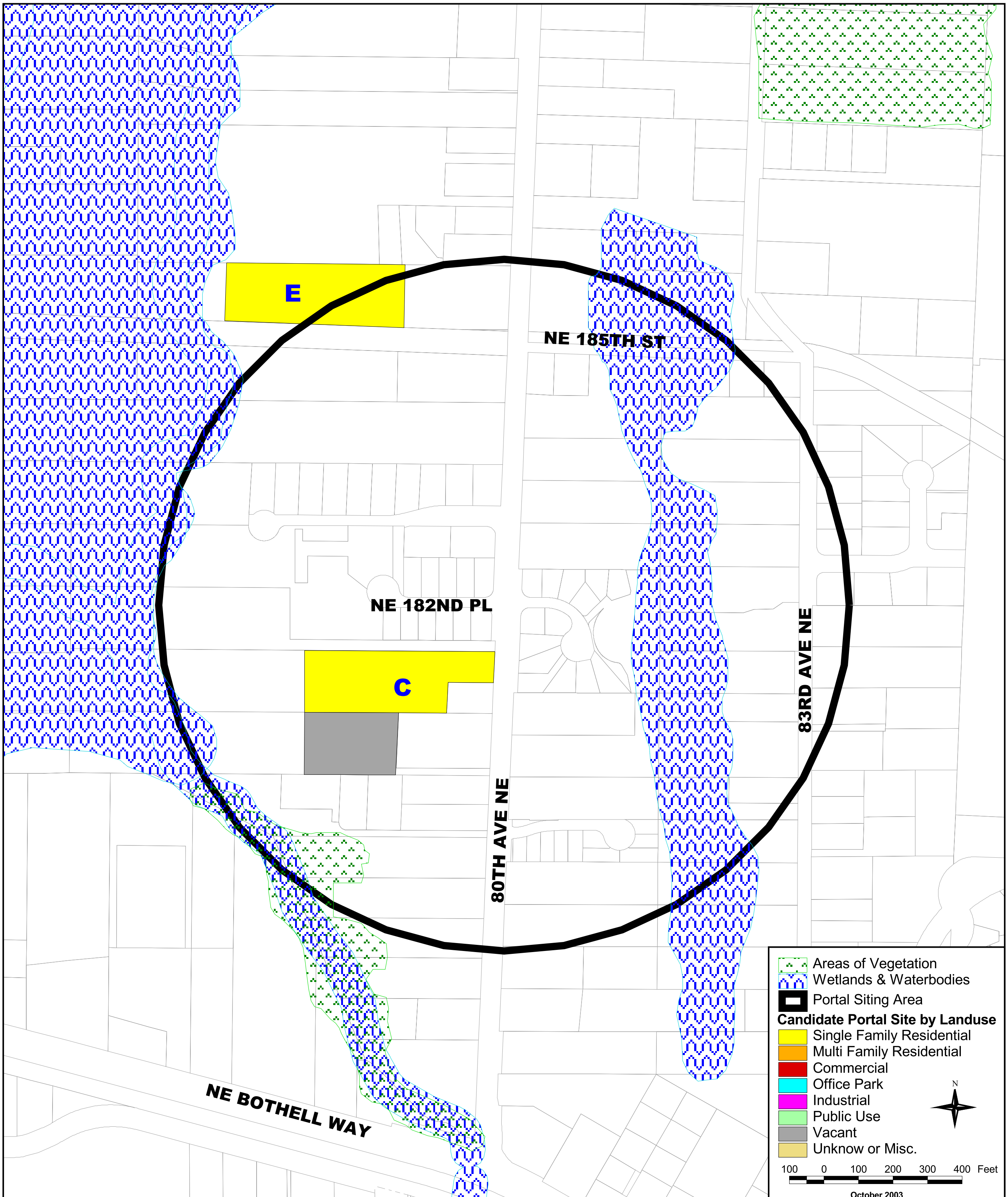

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Figure 6-B

Portal Siting Area 12
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

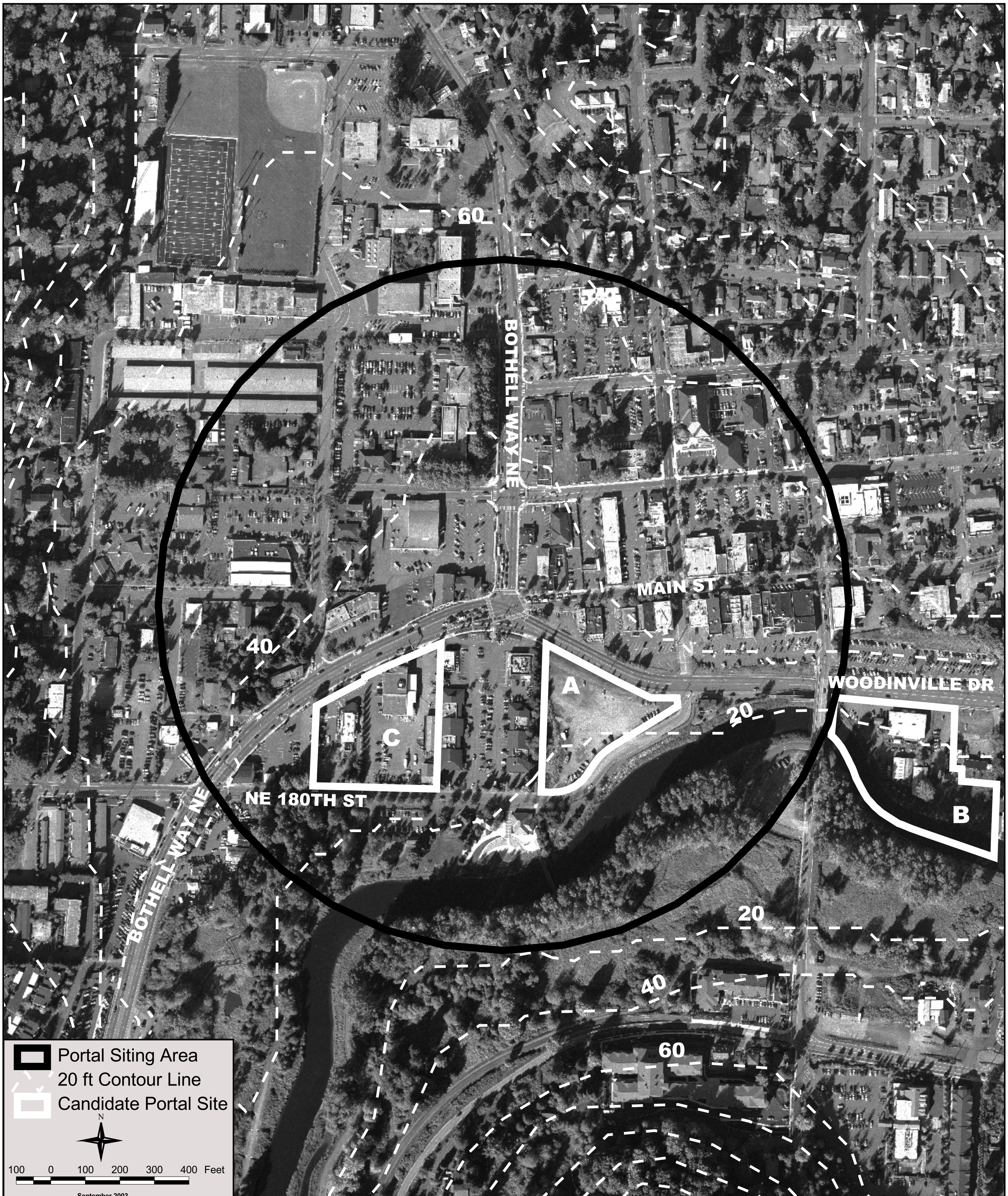

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Figure 7-A

Portal Siting Area 13
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

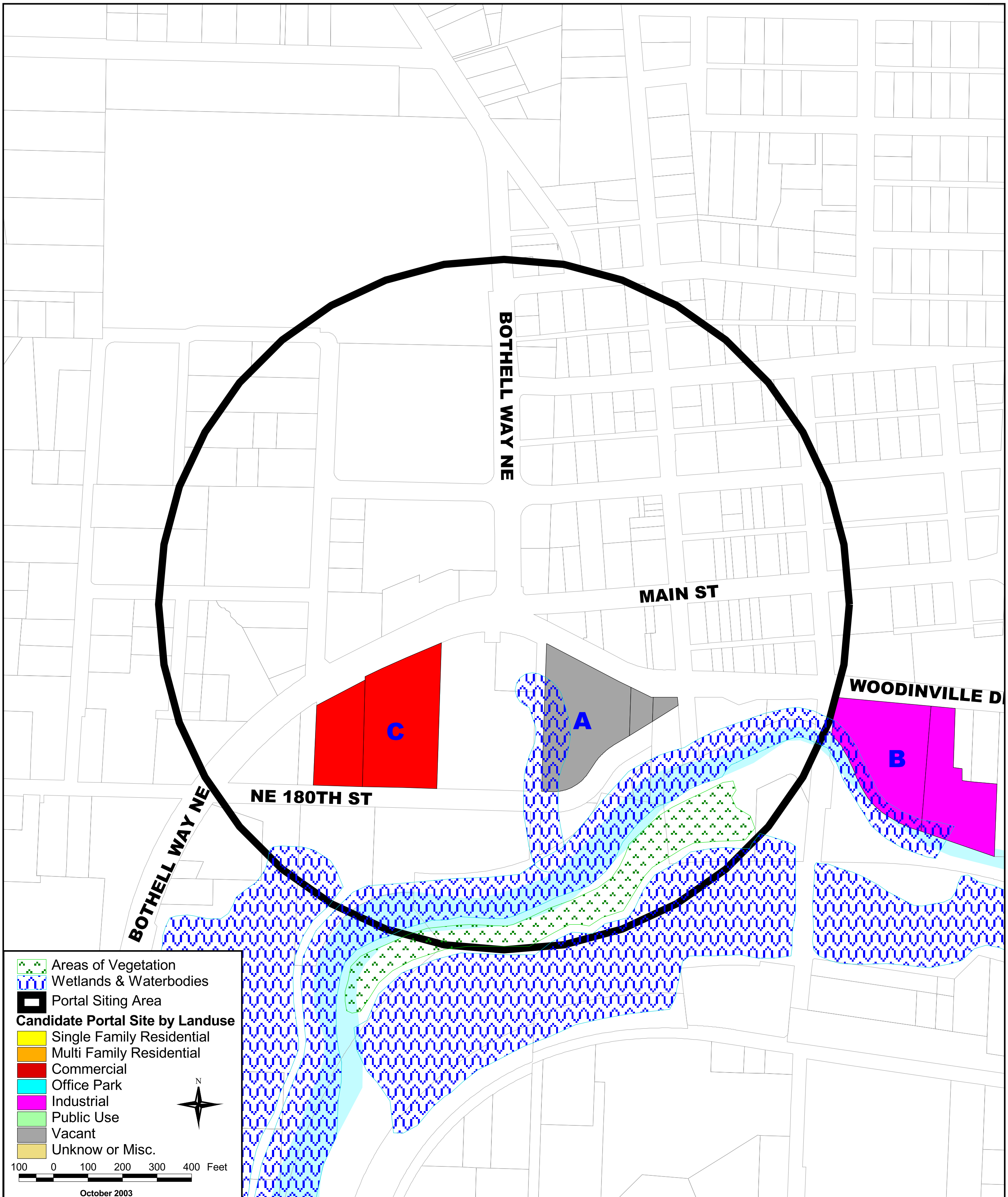

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Figure 7-B

Portal Siting Area 13
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

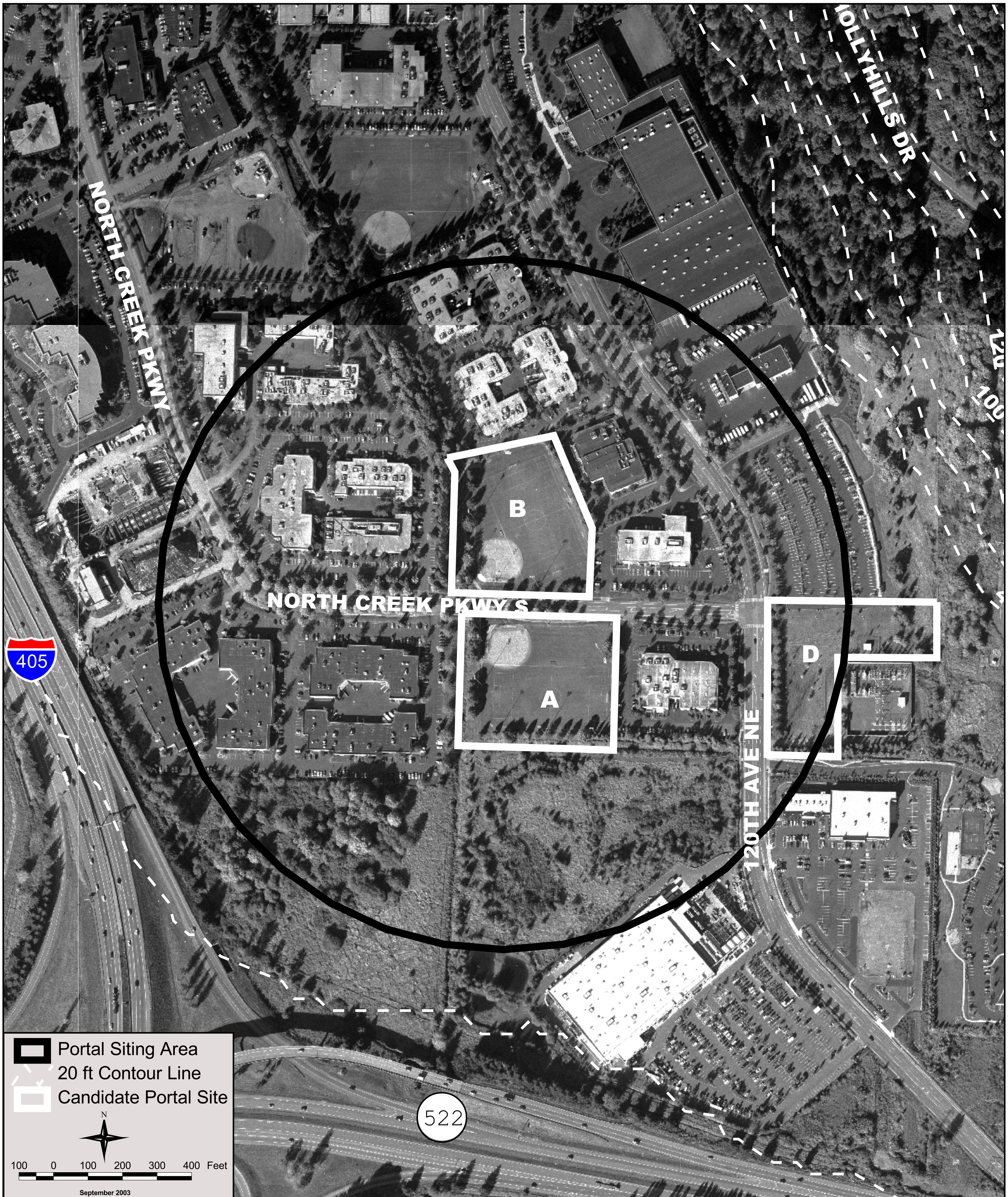

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Figure 8-A

Portal Siting Area 14
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

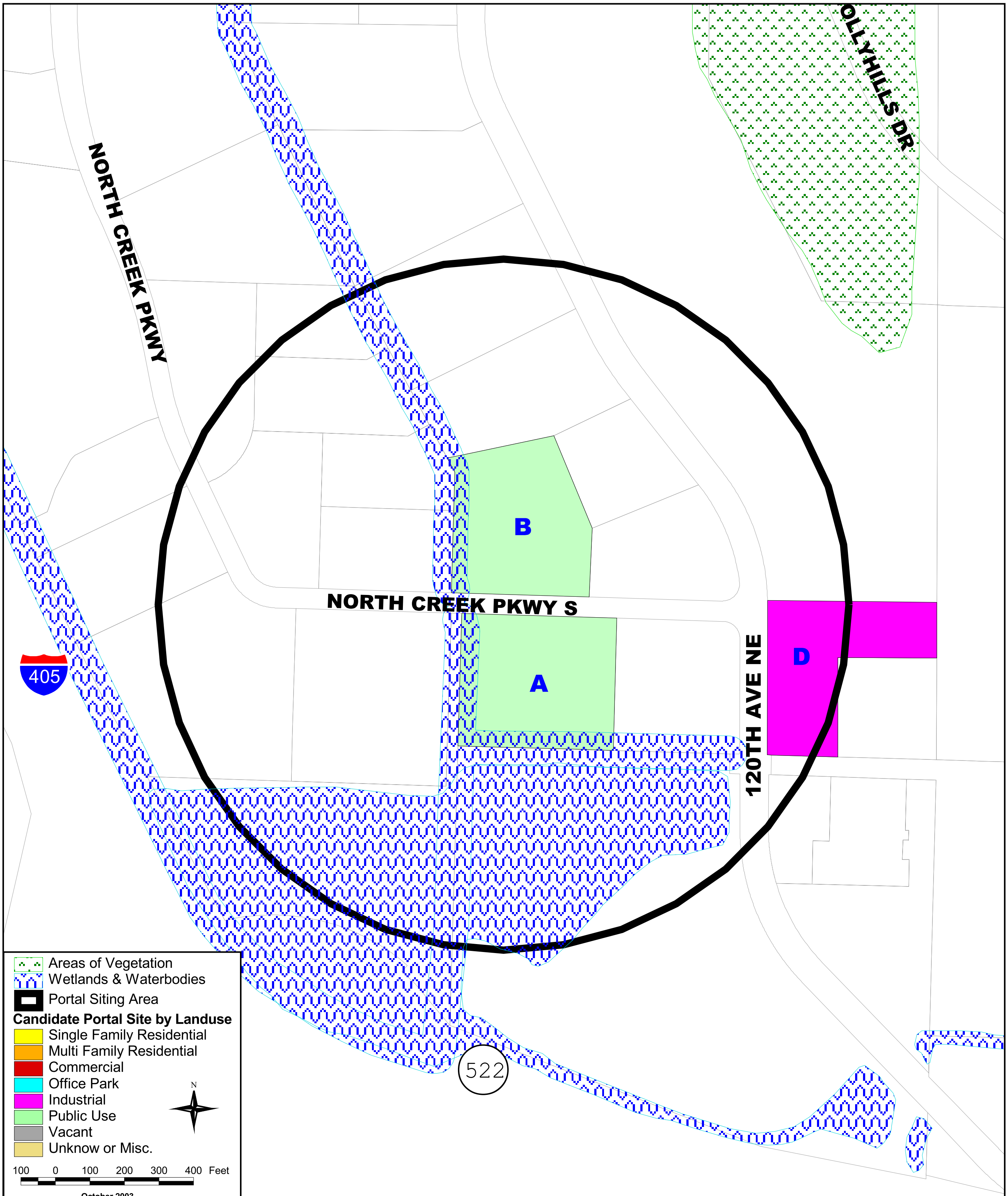

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Figure 8-B

Portal Siting Area 14
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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Figure 9-A

Portal Siting Area 19
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

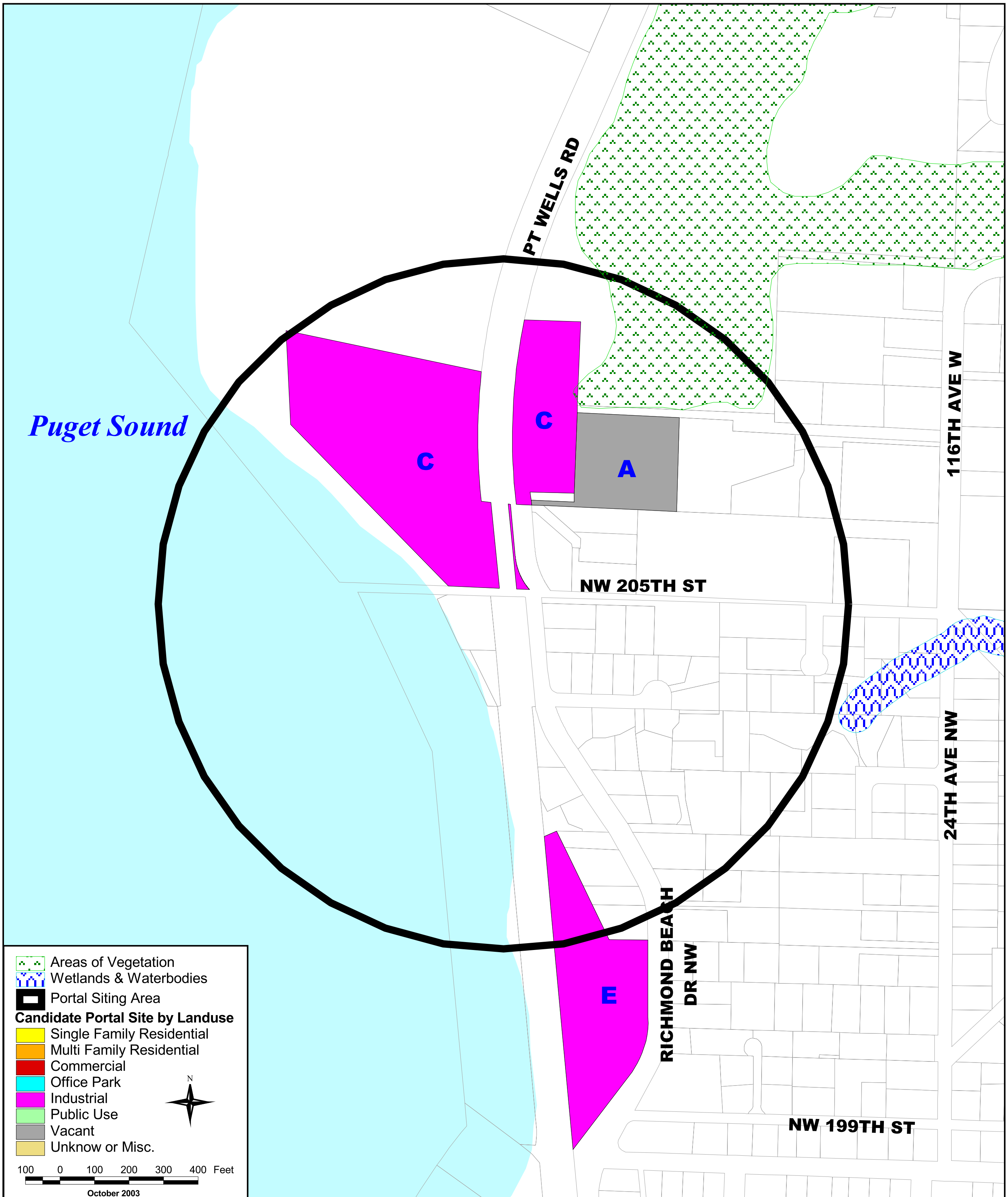

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Figure 9-B

Portal Siting Area 19
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

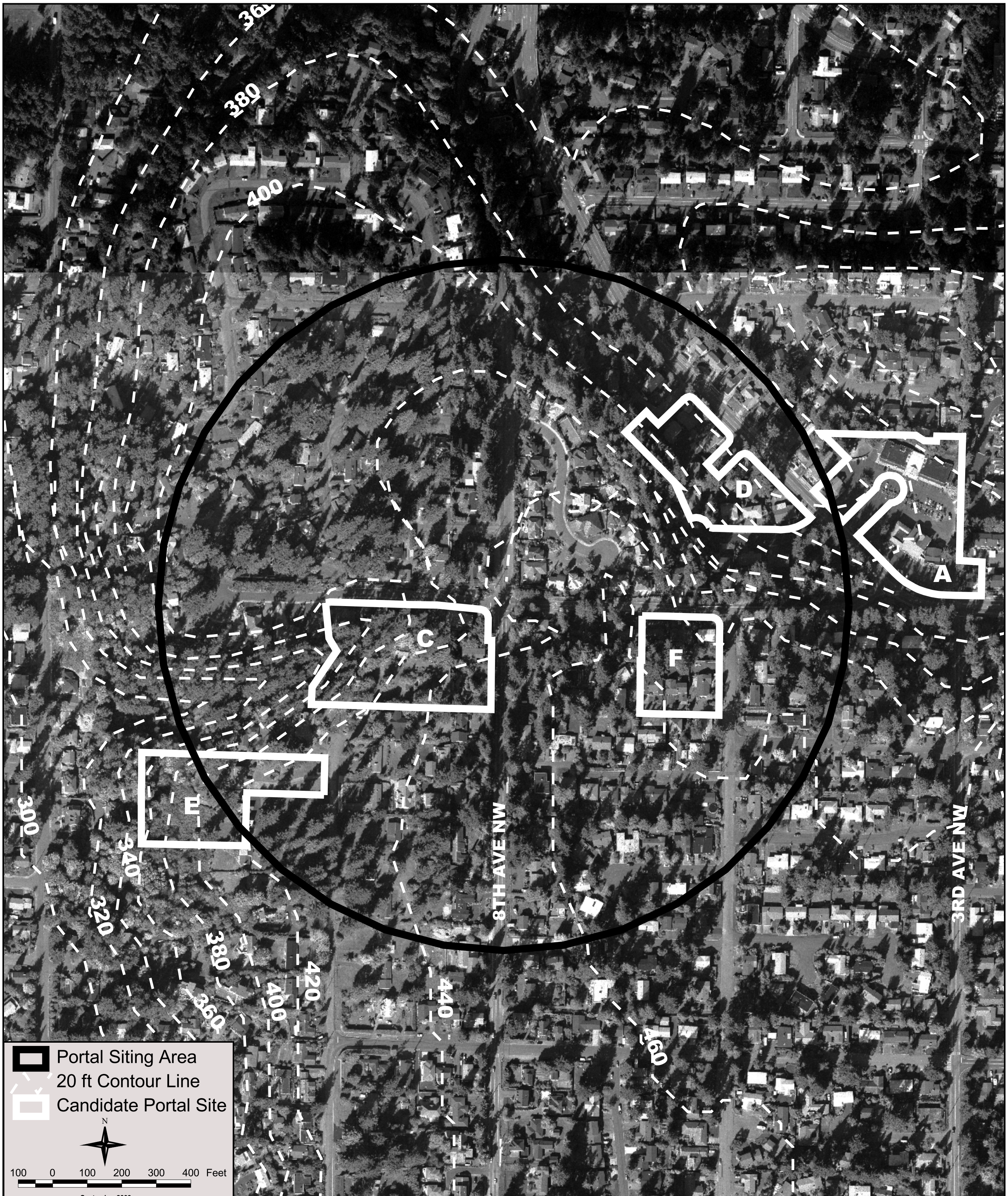

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Figure 10-A

Portal Siting Area 22
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

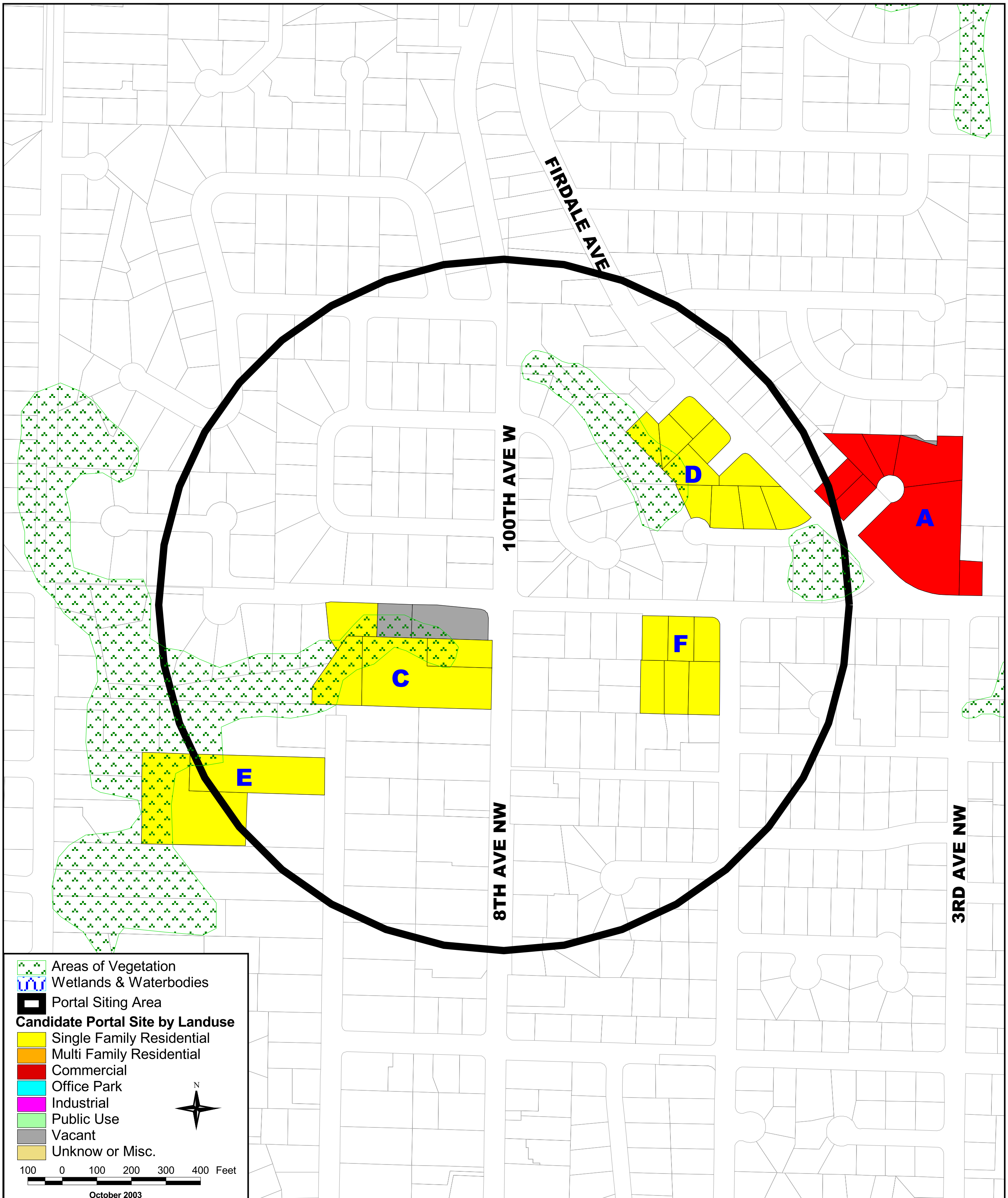

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Figure 10-B

Portal Siting Area 22
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

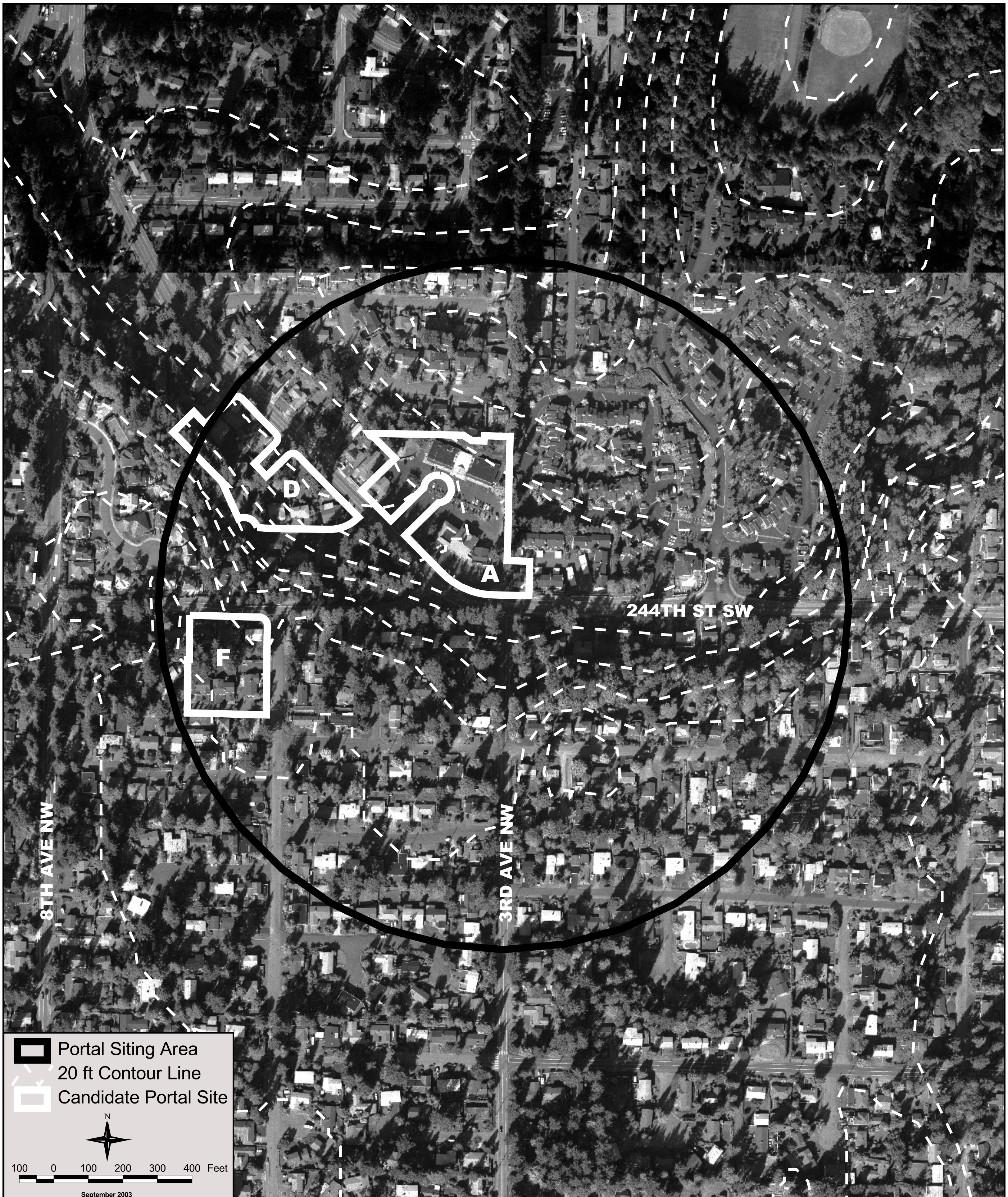

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Figure 11-A

Portal Siting Area 23
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

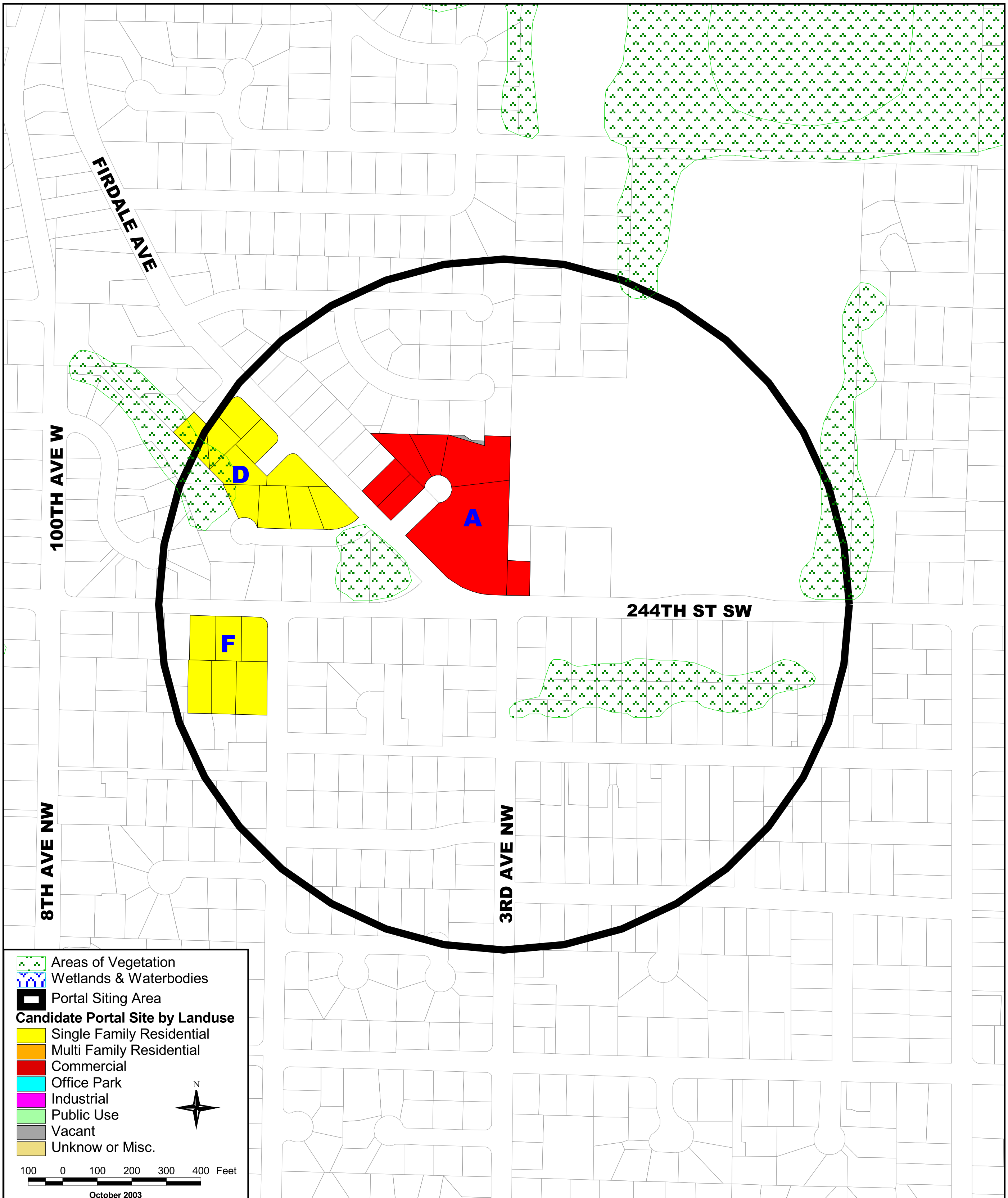

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Figure 11-B

Portal Siting Area 23
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

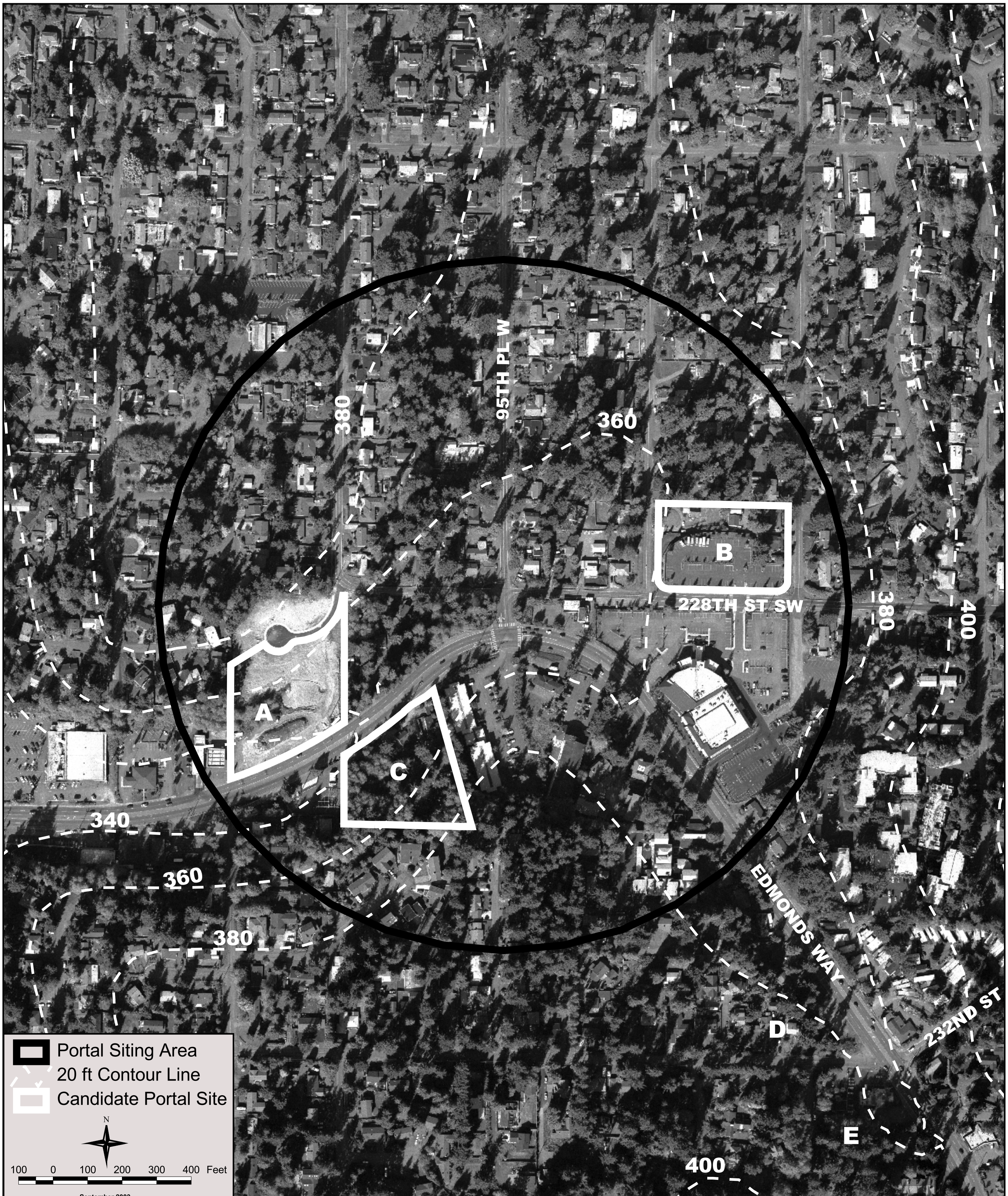

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Figure 12-A

Portal Siting Area 24
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

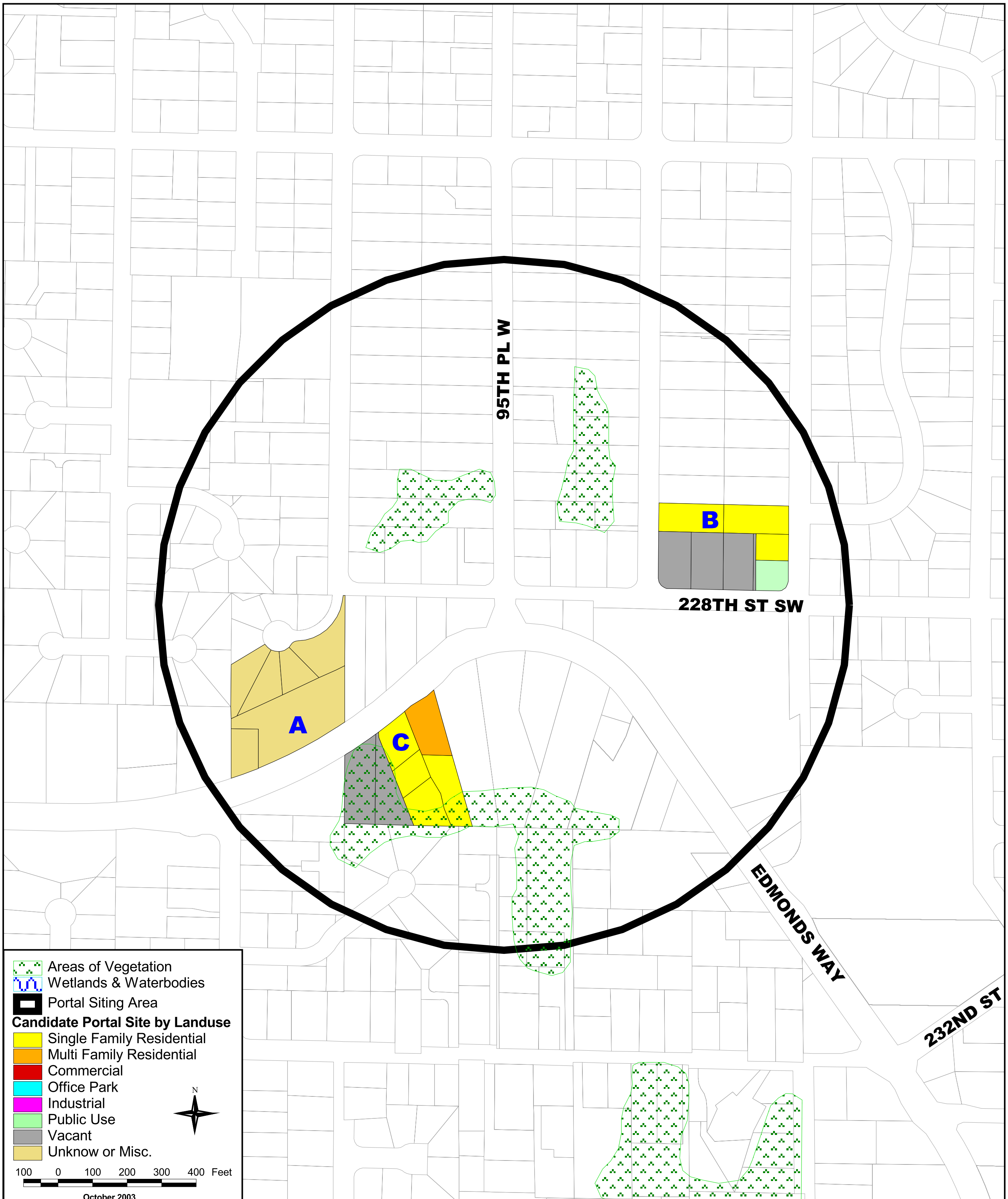

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Figure 12-B

Portal Siting Area 24
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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Figure 13-A
Portal Siting Area 26
Candidate Portal Sites
BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

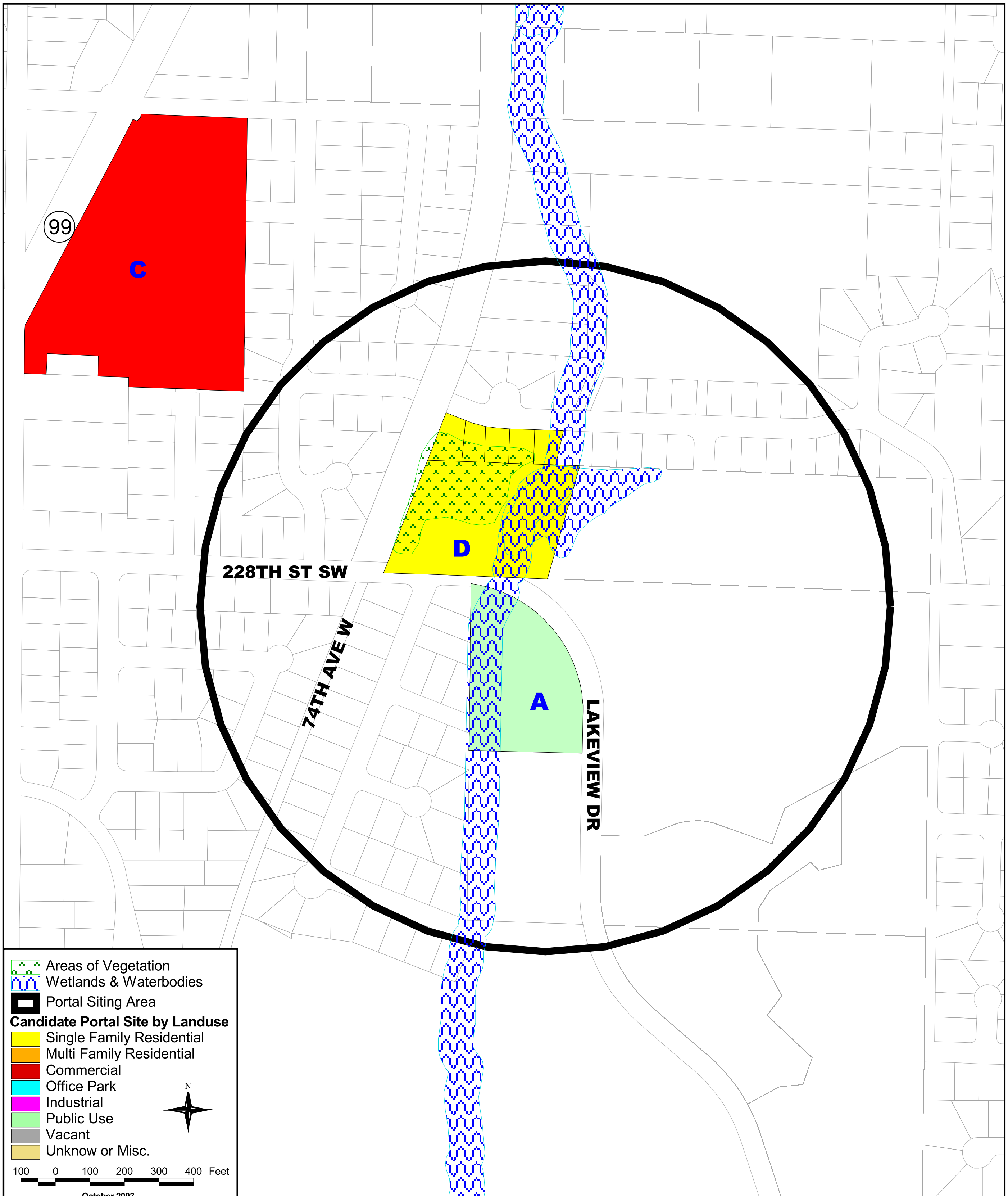

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Figure 13-B

Portal Siting Area 26
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

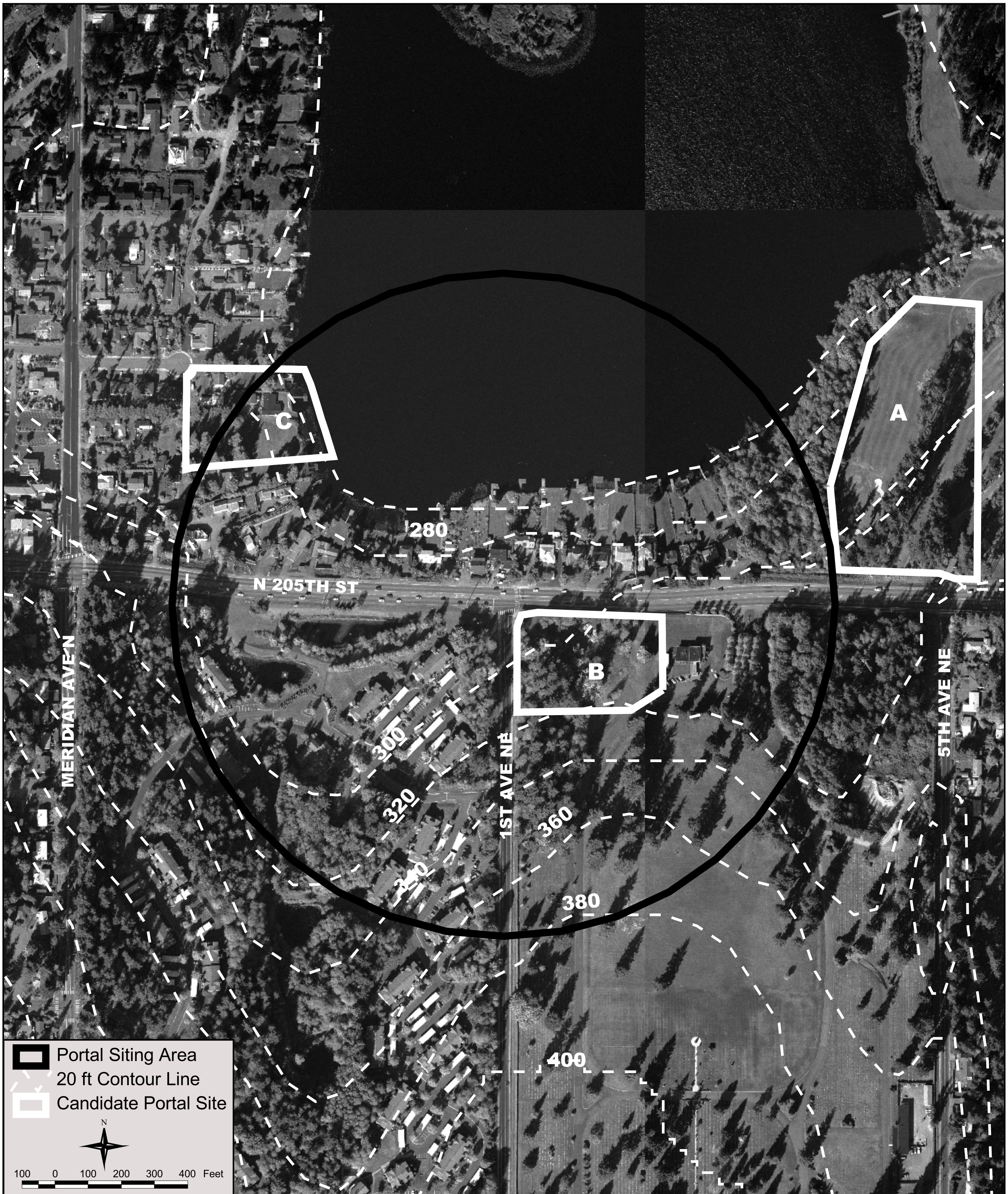

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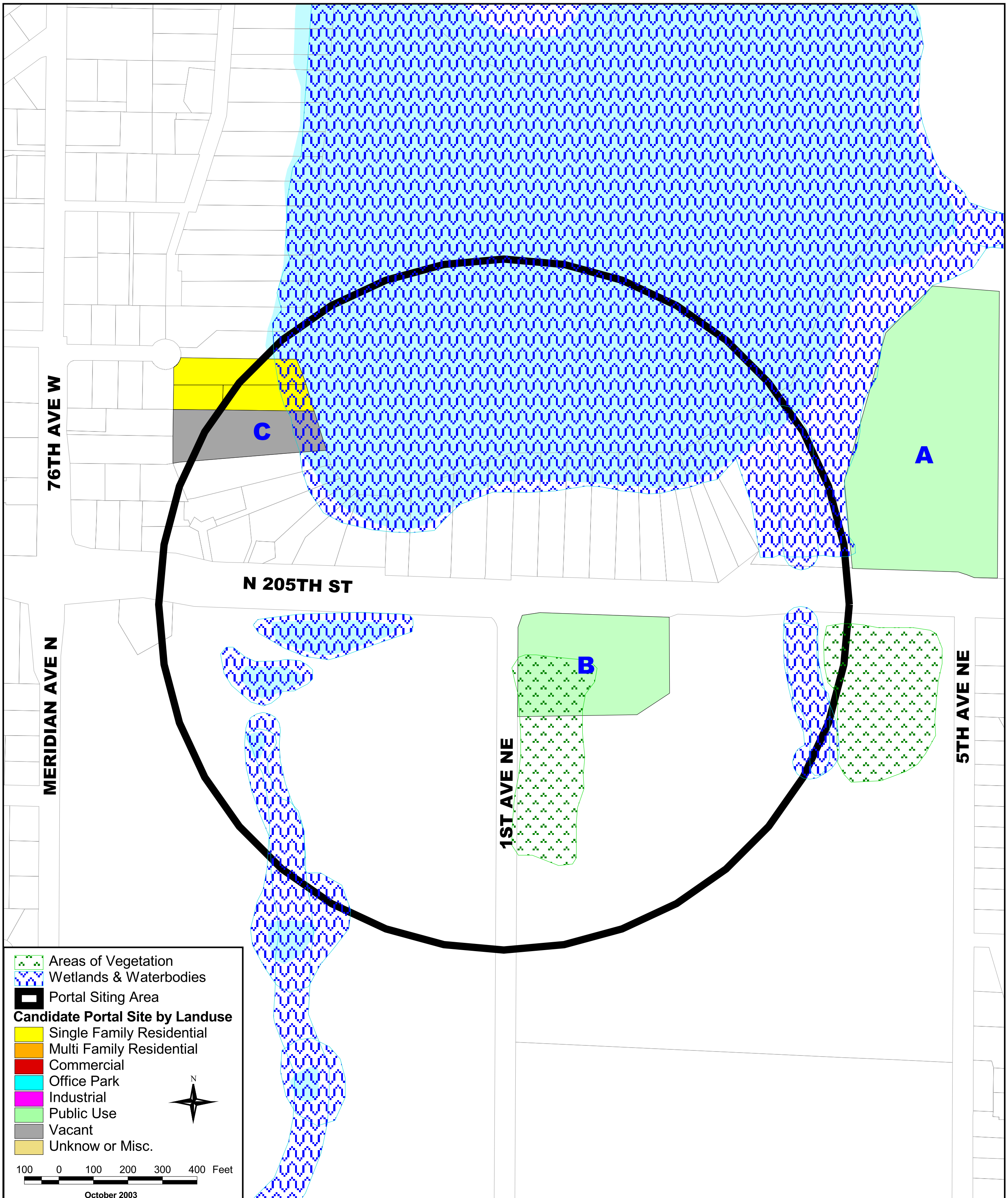
Figure 14-A
Portal Siting Area 27
Candidate Portal Sites
BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



King County
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Data Source: King County

File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross

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Figure 14-B

Portal Siting Area 27
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

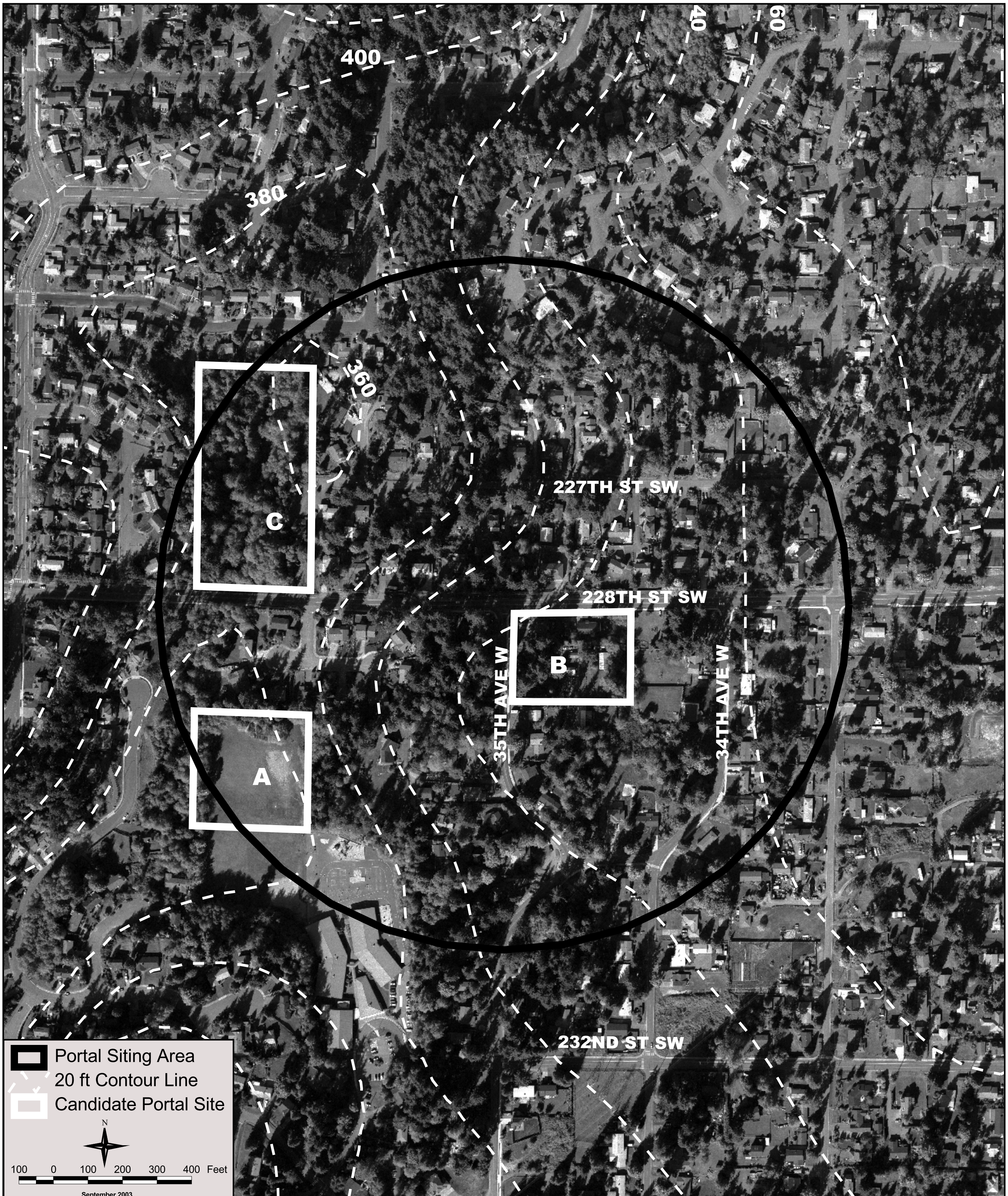

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Figure 15-A
Portal Siting Area 30 Candidate Portal Sites
BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

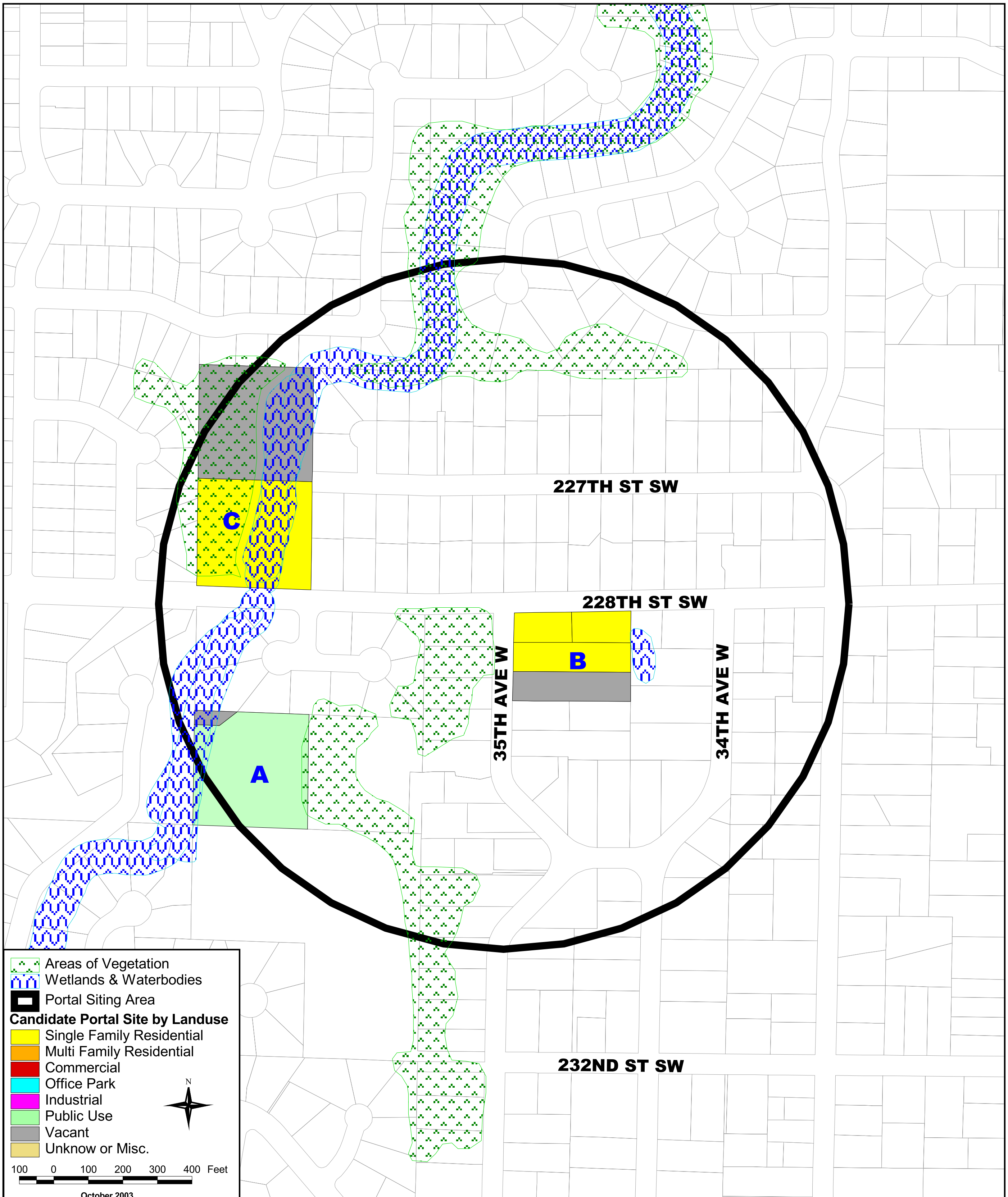

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Figure 15-B

Portal Siting Area 30
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

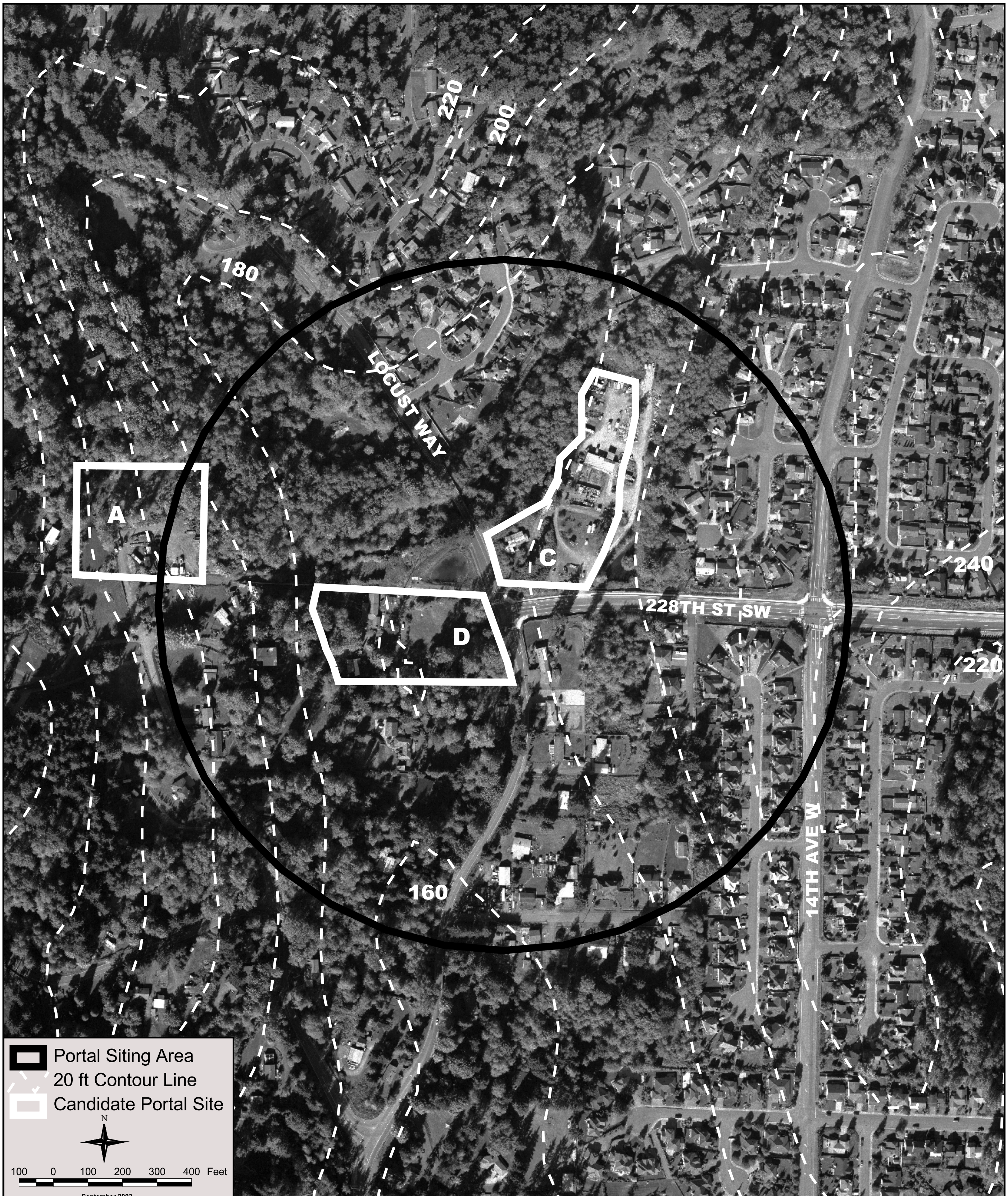

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Figure 16-A

Portal Siting Area 33
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

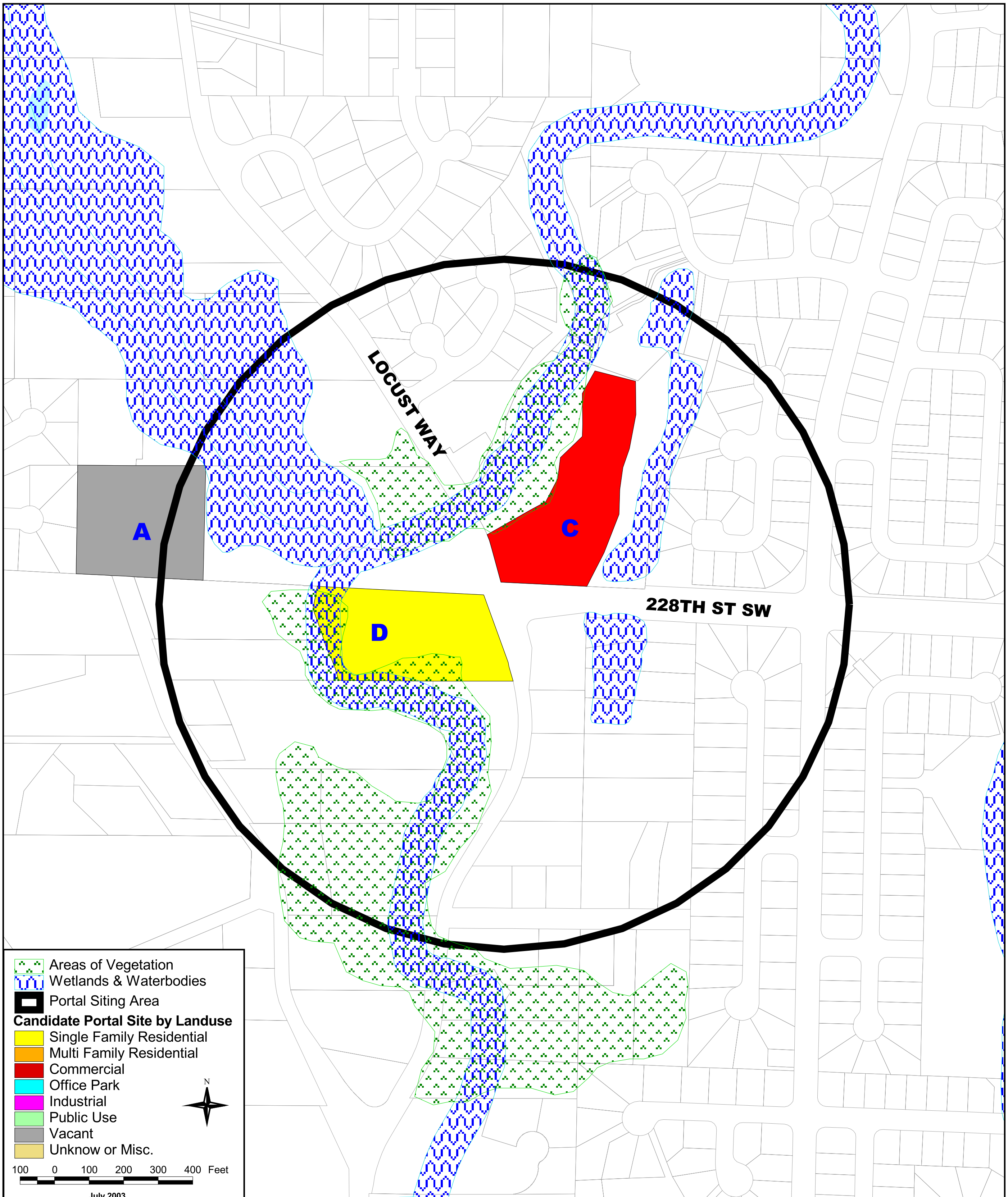

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Figure 16-B

Portal Siting Area 33
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

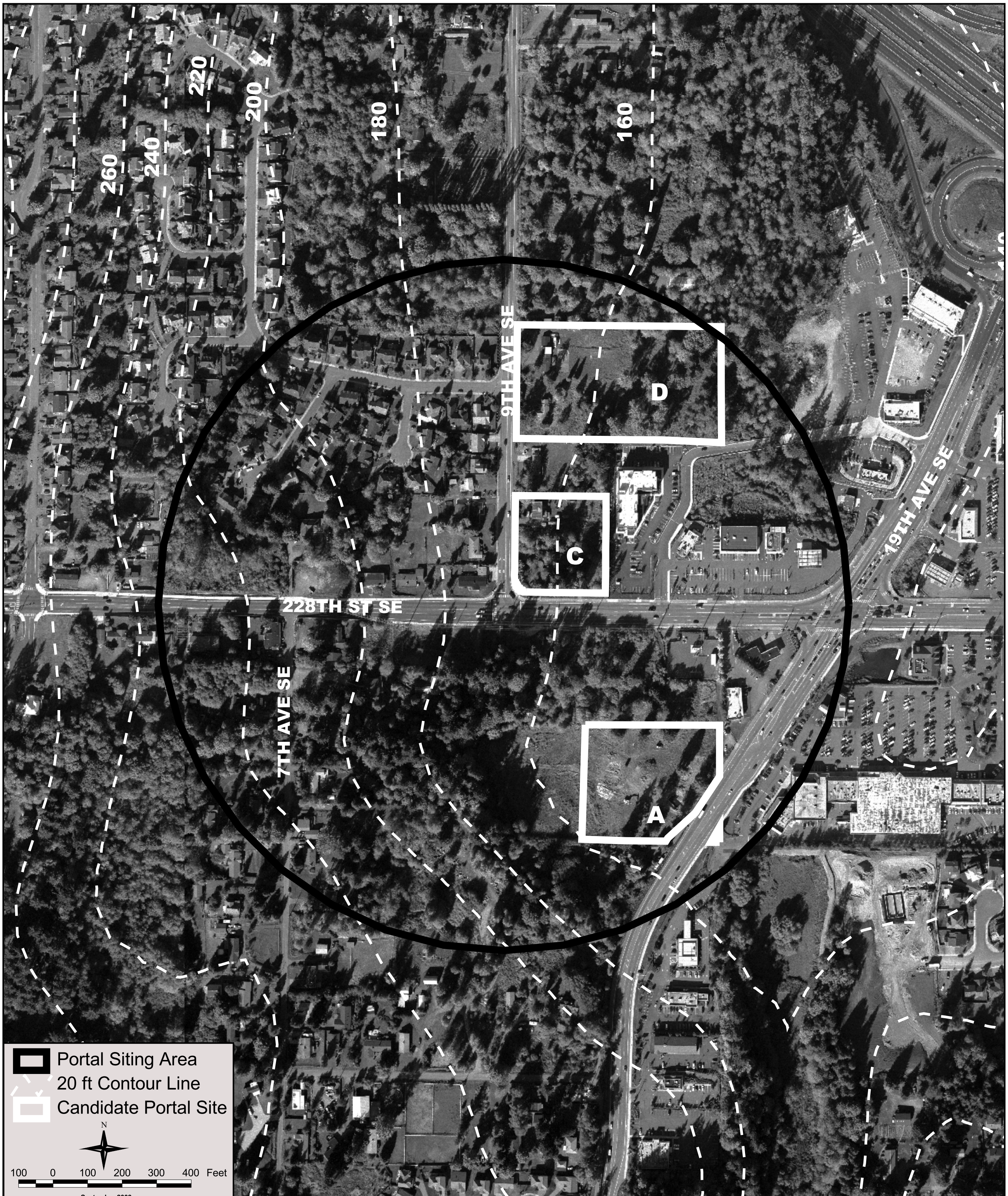

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Figure 17-A

Portal Siting Area 37
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

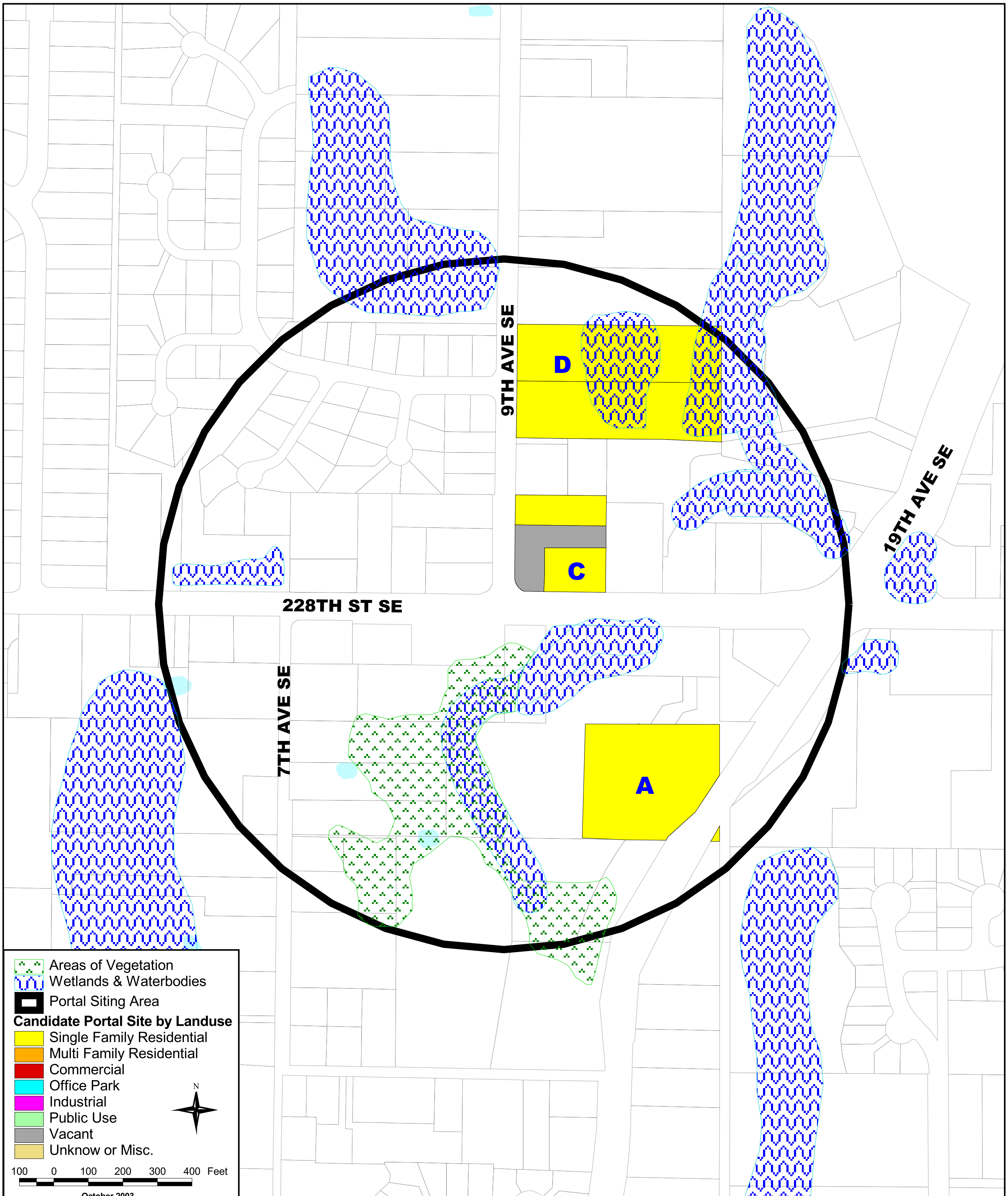

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Figure 17-B

Portal Siting Area 37
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

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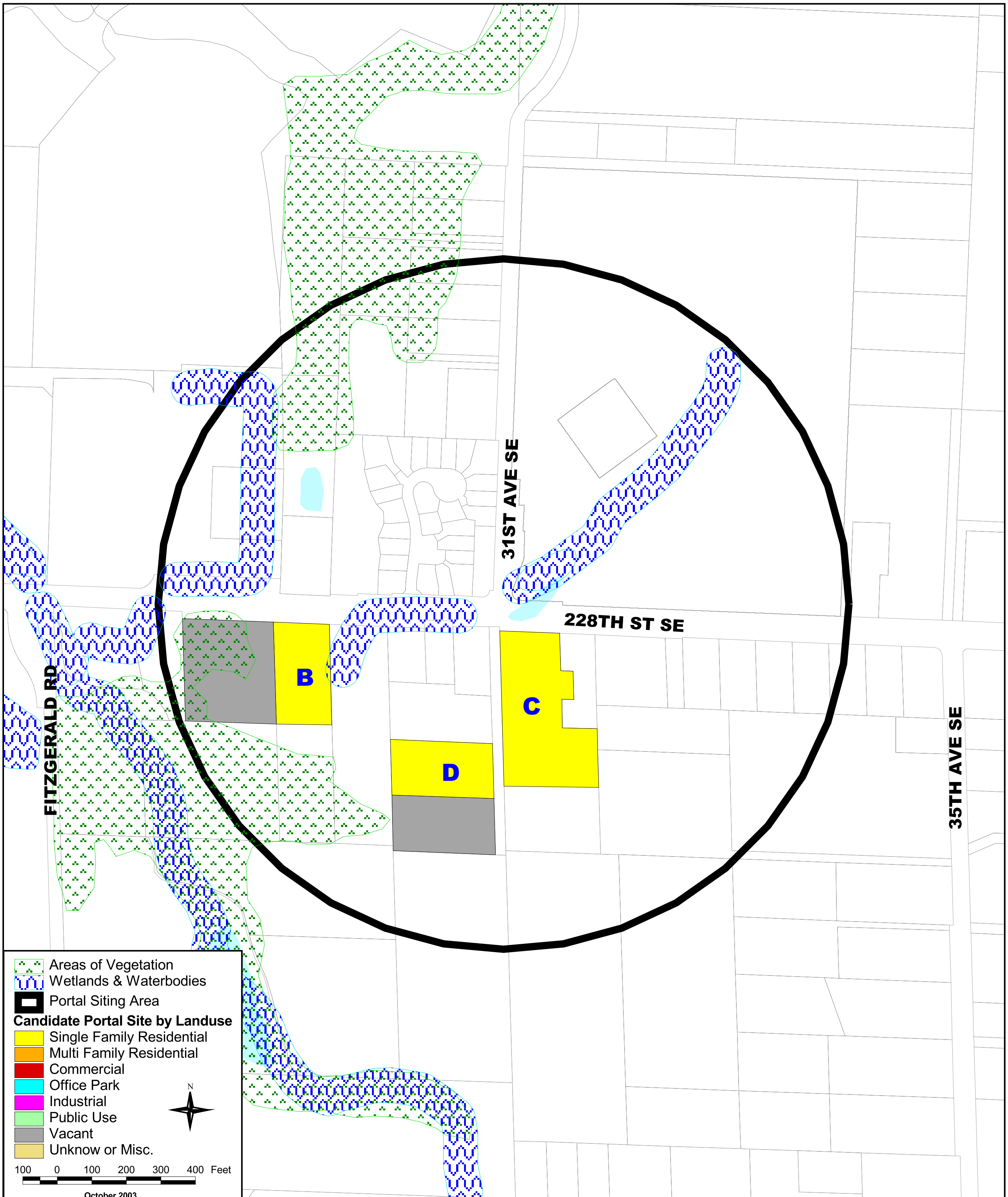
Figure 18-A
Portal Siting Area 39
Candidate Portal Sites
BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



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File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross

Prepared by: King County WTD GIS

Figure 18-B

Portal Siting Area 39
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

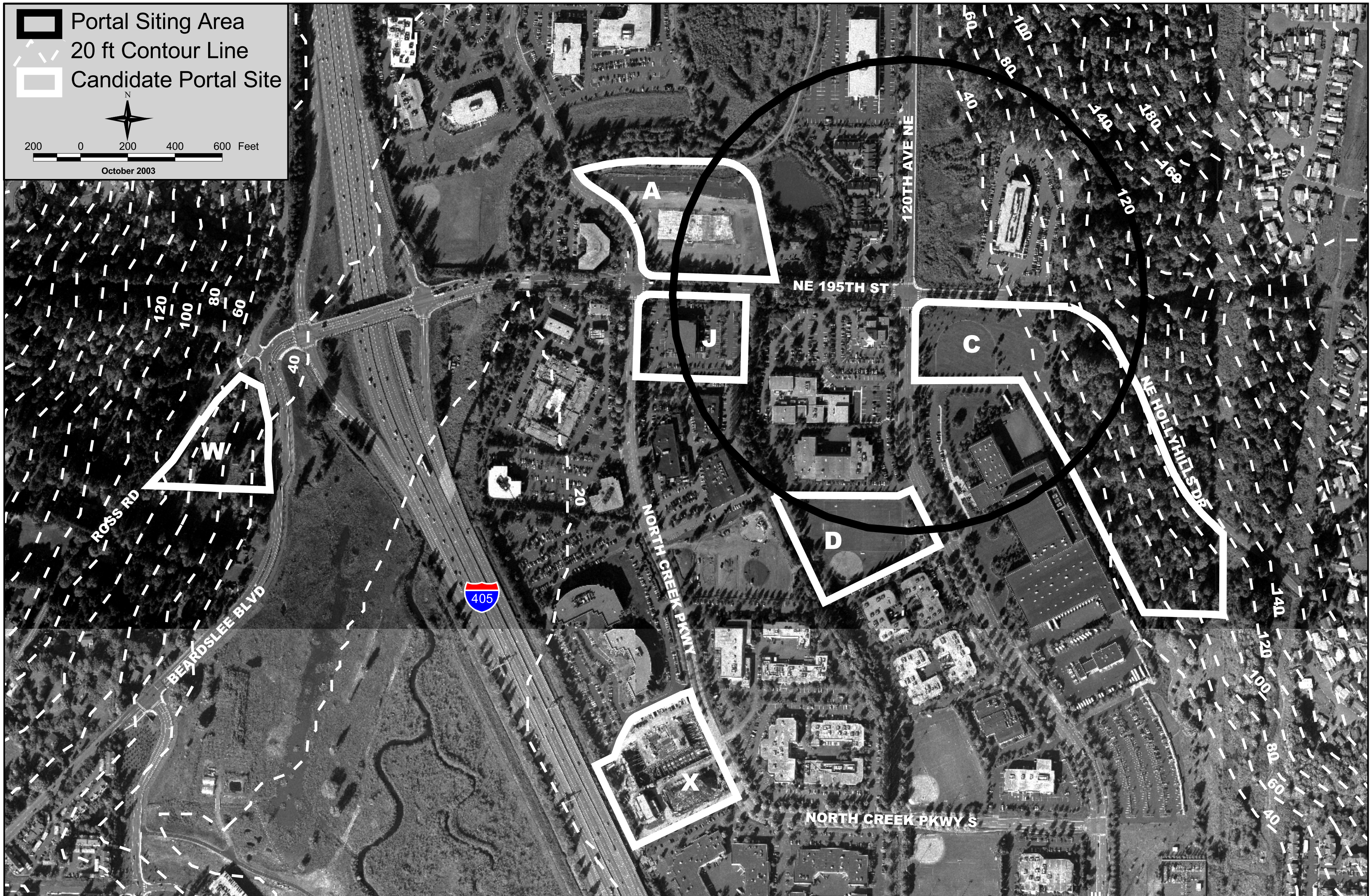

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Figure 19-A

Portal Siting Area 41
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM

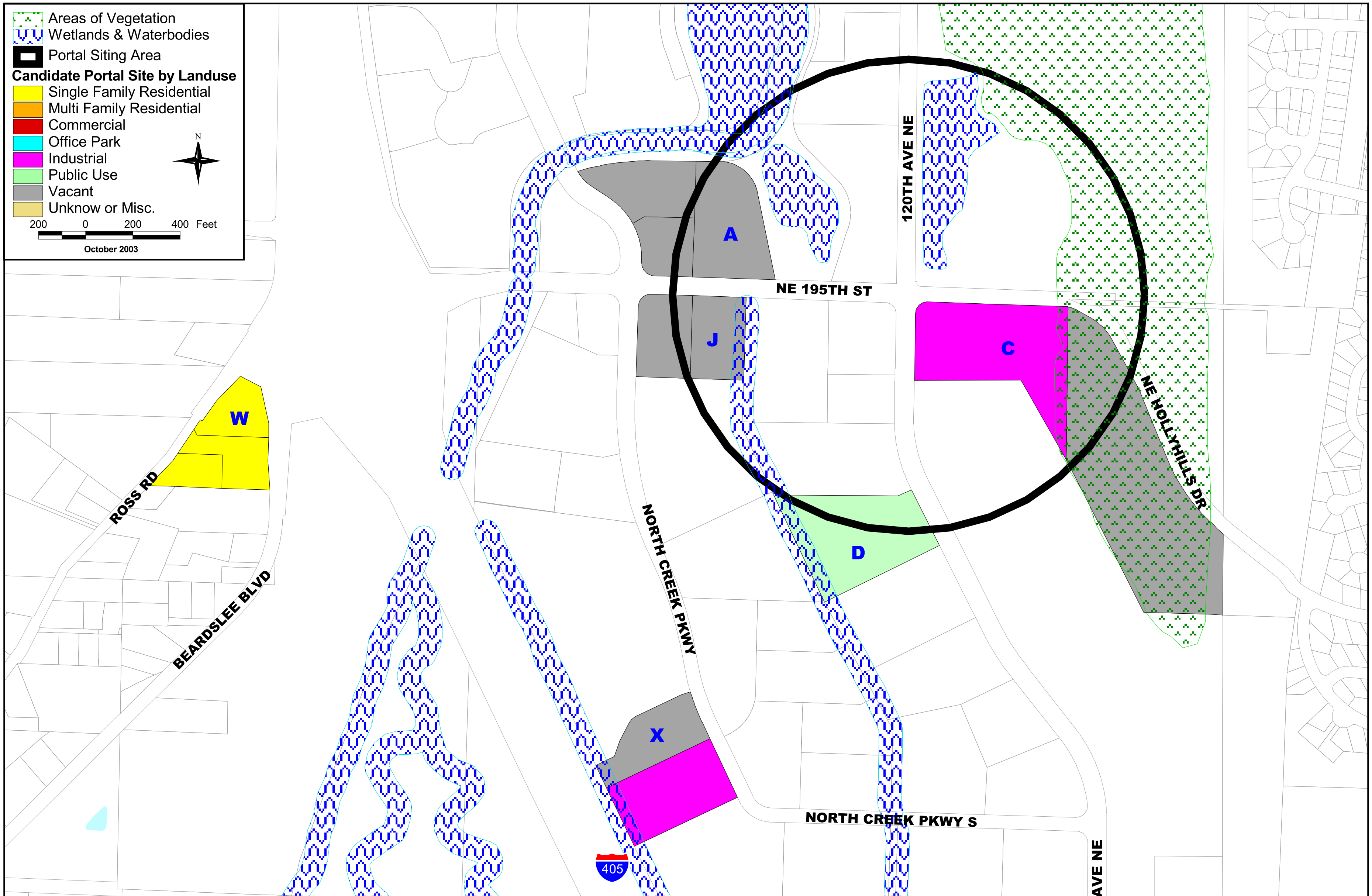

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Figure 19-B

Portal Siting Area 41
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM

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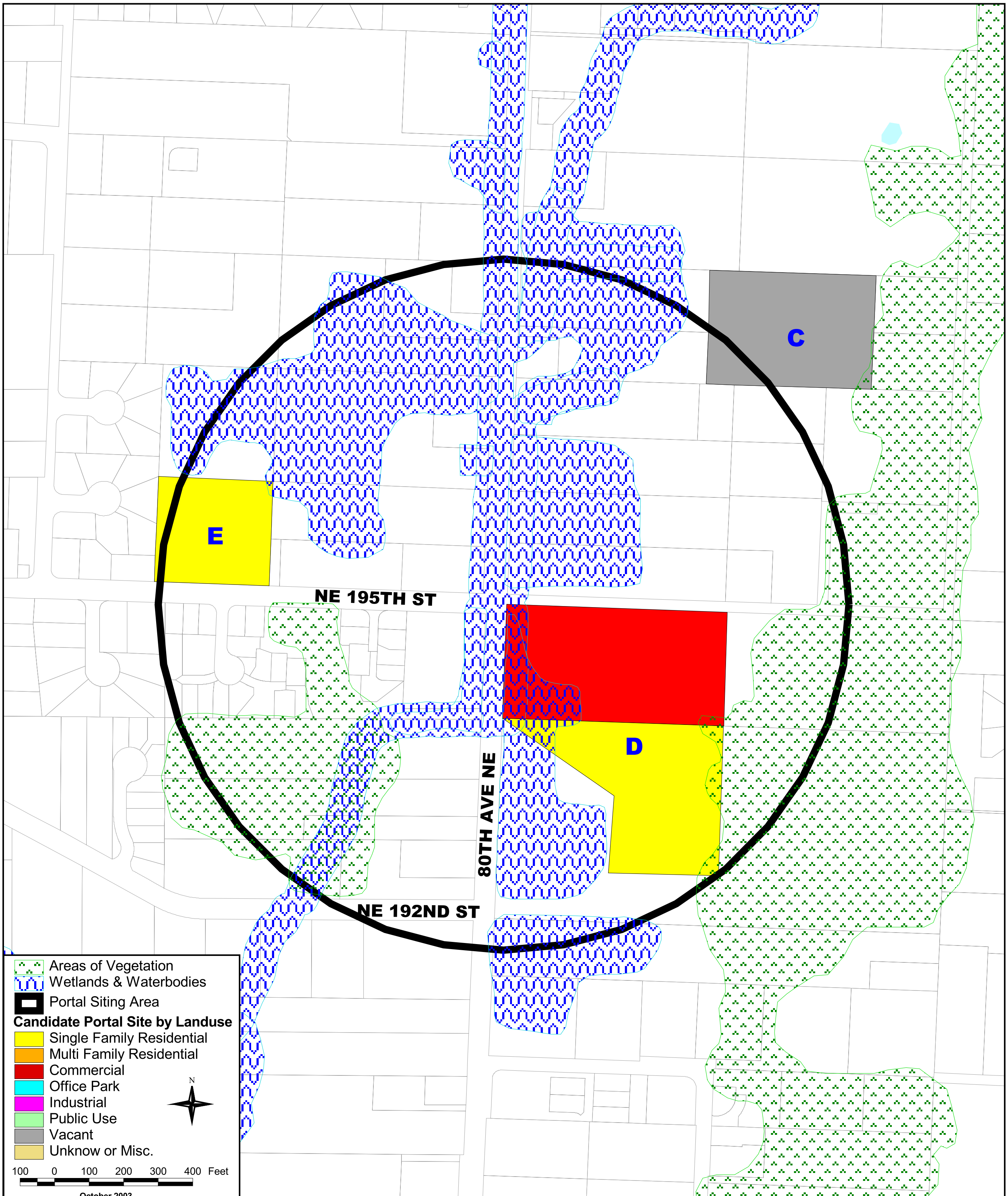
Figure 20-A

Portal Siting Area 44
Candidate Portal Sites

BRIGHTWATER REGIONAL
WASTEWATER TREATMENT SYSTEM



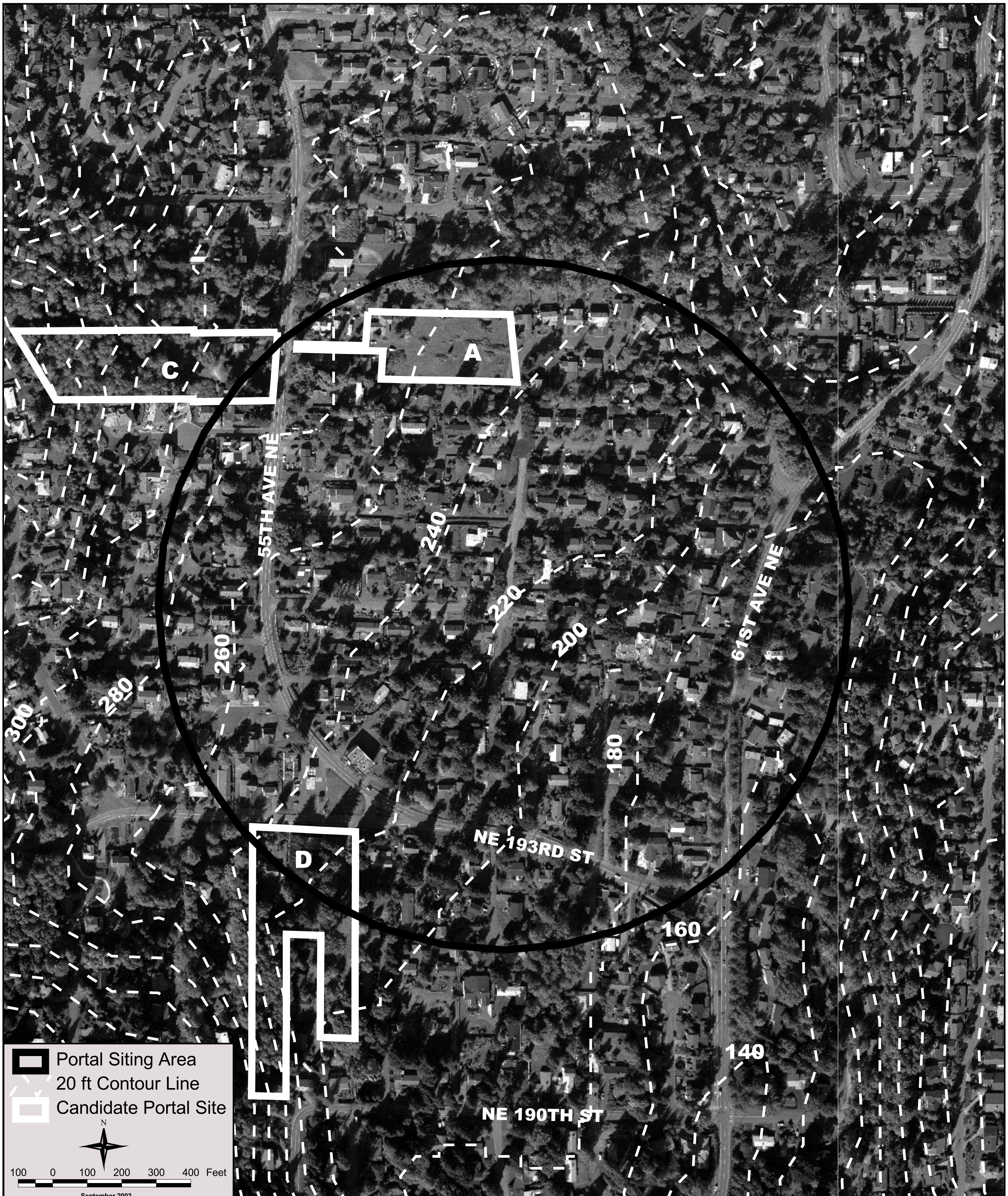
King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross
Prepared by: King County WTD GIS

Figure 20-B

Portal Siting Area 44
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



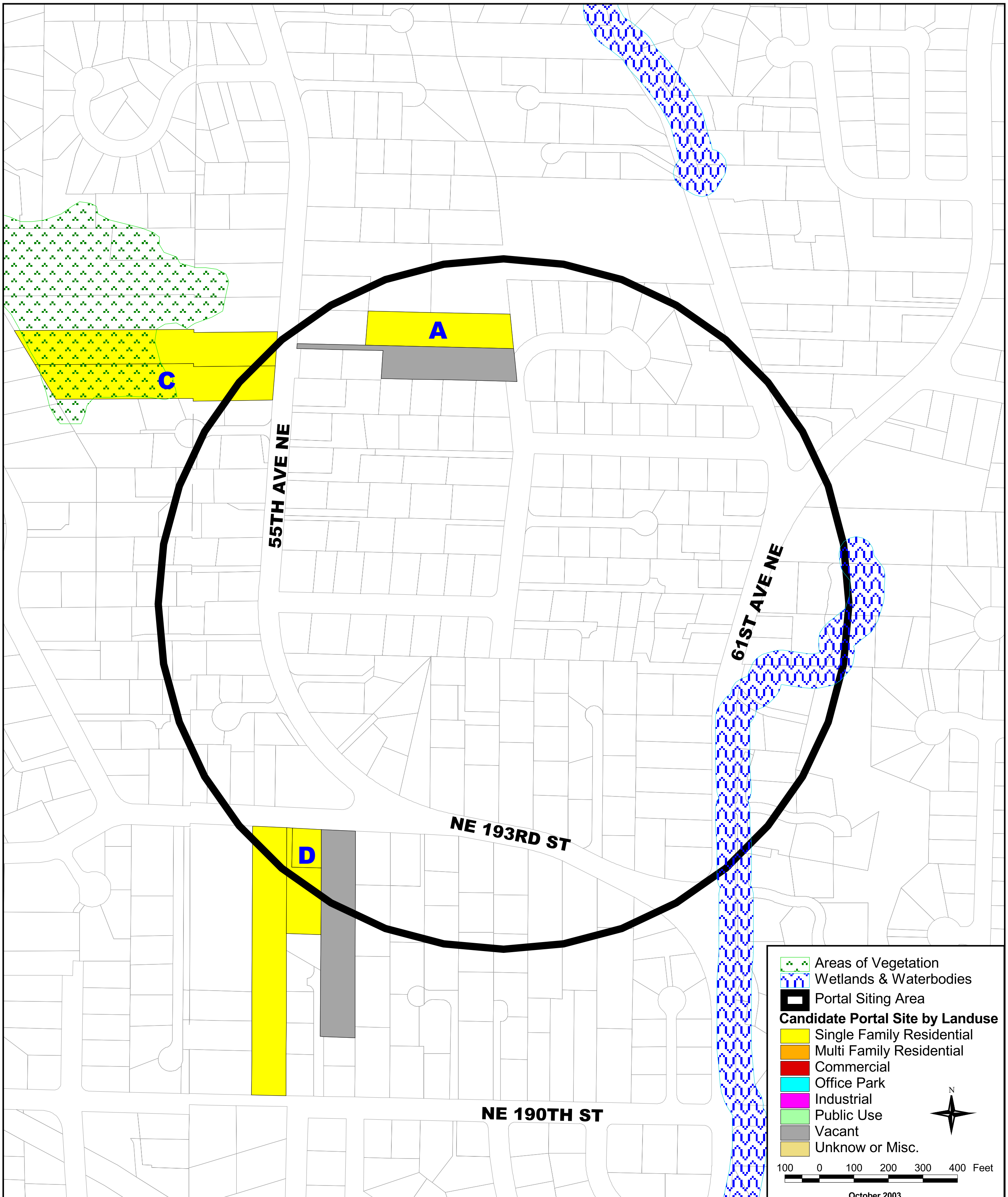
King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels.apr Shari Cross
Prepared by: King County WTD GIS

Figure 21-A

Portal Siting Area 45
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

Data Source: King County
File Name: dnrp1:\\WTD\Projects\BW_FEIS\projects\portal_parcels_lev2.apr Shari Cross
Prepared by: King County WTD GIS

Figure 21-B

Portal Siting Area 45
Candidate Portal Sites

BRIGHTWATER REGIONAL WASTEWATER TREATMENT SYSTEM